

Figure 8-9. Receiver Complete Schematic Wiring Diagram





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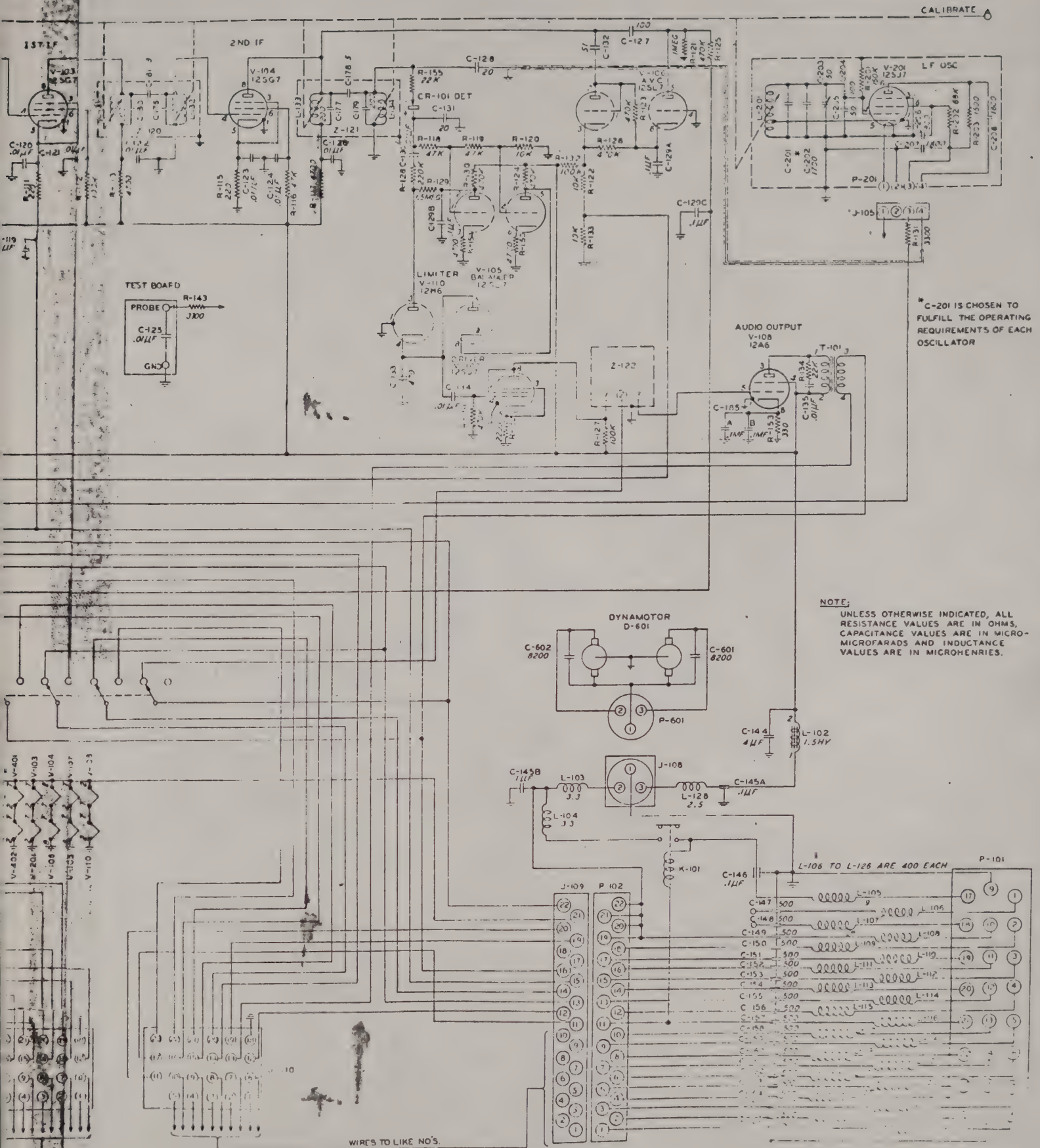


Figure 8-9. Receiver Complete Schematic Wiring Diagram









51H-3  
AIRCRAFT RECEIVER

INSTRUCTION BOOK







INSTRUCTION BOOK

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*for*

AIRCRAFT RADIO EQUIPMENT

MODEL 51H-3 RADIO RECEIVING EQUIPMENT

MANUFACTURED BY

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA, U.S.A.

520 9294 00

11819







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### WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL SHOULD AT ALL TIMES OBSERVE ALL THE SAFETY RULES LISTED BELOW. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WHEN HIGH VOLTAGE SUPPLY ON. DO NOT DEPEND UPON DOOR SWITCHES FOR PROTECTION BUT ALWAYS SHUT DOWN POWER EQUIPMENT AND OPEN MAIN SWITCH IN POWER SUPPLY CIRCUIT. ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

Since the use of high voltages which are dangerous to human life is necessary to the successful operation of the radio transmitting equipment covered by these instructions, certain precautionary measures must be carefully observed by the operating personnel during the adjustment and operation of the equipment.

The major portions of the equipment are within metal cabinet enclosures, provided with access doors which are generally fitted with safety interlock switches which remove dangerous voltages within the cabinets when access doors are open.

Interlocks are also provided on certain removable panels within the cabinets. Other panels, if removed, will not cause interlocks to function and will thereby allow access to circuits carrying voltages dangerous to human life.

**KEEP AWAY FROM LIVE CIRCUITS:** Under no circumstances should any person reach within a cabinet with interlocked gates while power supply line switches to the equipment are closed; or handle any portion of exposed equipment which is supplied with power; or to connect any apparatus external to the cabinets to circuits within the cabinets; or to apply high voltages to the equipment even for testing purposes while any non-interlocked portion of the cabinet is removed. Whenever feasible in testing circuits, make continuity and resistance checks rather than directly checking voltage at various points when any high voltage is applied to the transmitter circuits.

**DON'T SERVICE OR ADJUST ALONE:** Under no circumstances should any person reach within a cabinet for the purpose of servicing or adjusting the equipment without the presence or assistance of another person capable of rendering aid.

**DON'T TEMPER WITH INTERLOCKS:** Door or safety interlock switches should not be removed or short circuited, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.





### GUARANTEE

This equipment is guaranteed against defects in material, workmanship or manufacture, for a period of one year from the date of delivery. Our obligation under this guarantee is limited to repairing or replacing any item which shall prove, by our examination, to be thus defective, provided the item is returned to the factory for inspection with all transportation charges paid. Before returning any item believed to be of defective material, workmanship or manufacture, a detailed report must be submitted to the company giving exact information as to the nature of the defect. The information shall include, in as much detail as possible, all subject material listed under instructions for replacement of parts. Upon receipt of the report by the company, detailed instructions as to how the equipment is to be returned will be issued. Do not return any material until instructed to do so by the company.

COLLINS RADIO COMPANY

### REPLACEMENT OF PARTS

In case a replacement under the guarantee is desired, a full report must be submitted to the company. This report shall cover all details of the failure and must include the following information:

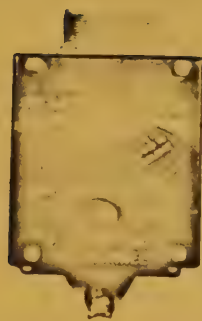
- (A) Date of delivery of equipment.
- (B) Date placed in service.
- (C) Number of hours in service.
- (D) Part number of item.
- (E) Item number (obtain from Parts List or Schematic Diagram).
- (F) Type number of unit from which part is removed.
- (G) Serial number of unit.
- (H) Serial number of the complete equipment.
- (I) Nature of failure.
- (J) Cause of failure.
- (K) Remarks.

When requisitioning replacement parts, the following information must be furnished:

- (A) Quantity required.
- (B) Part number of item.
- (C) Item number (obtain from Parts List or Schematic Diagram).
- (D) Type number of unit.
- (E) Serial number of unit.
- (F) Serial number of equipment.

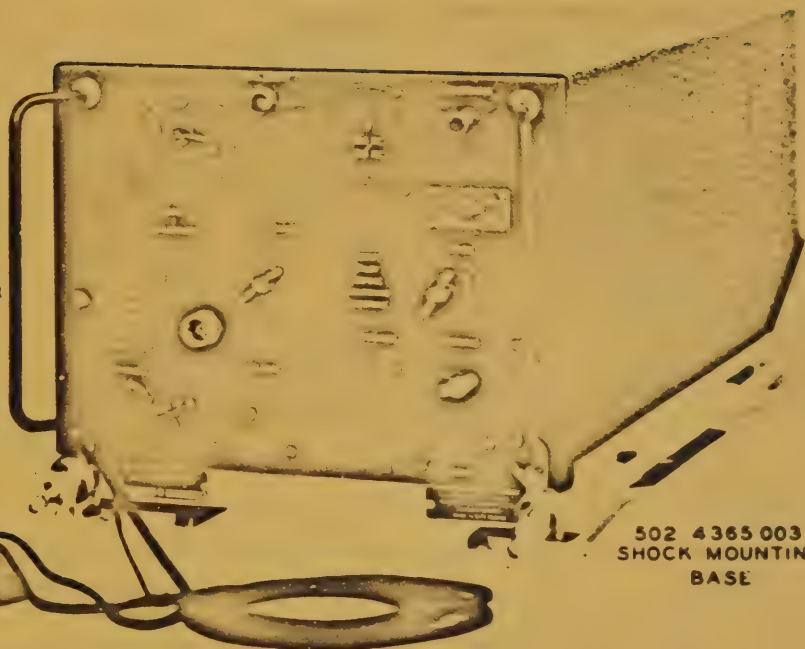
NOTE: Blank Service Report form will be found in the appendix of this instruction book.





314P-3 REMOTE  
CONTROL UNIT

51H-3 RECEIVER  
UNIT



502 4365 003  
SHOCK MOUNTING  
BASE



Figure 1-1 Type 51H-3 Receiving Equipment





## SECTION I

### GENERAL DESCRIPTION

#### 1. GENERAL.

This handbook has been compiled as a guide to the proper installation, adjustment, operation and maintenance of the Model 51H-3 Airborne Radio Receiver. Refer to figure 1-1 for identification of this equipment.

#### 2. EQUIPMENT SUPPLIED.

The following table lists the equipment supplied by the manufacturer together with the type number, size and weight of each unit:

Quantity per Equipment	Name of Part	Part Number	Overall Dimensions (Inches)	Weight	Numerical Series of Reference Symbols
1	Radio Receiver LF Oscillator HF Oscillator CFI Unit Relay Unit Dynamotor	520 2544 00	7-7/8 x 10-3/8 x 21-9/16	39.5 lb.	100-199 200-299 300-399 400-499 500-599 600-699
1	Remote Control Unit	520 3060 00	6-1/16 x 3-23/32 x 3-7/32	1.5 lb.	800-899
1	Power Connector	502 4349 003	1-5/16 x 2-15/32 x 4-15/16	11 oz.	900-999
1	Remote BFO Control	520 3094 00			
1	Receiver Mounting Base	502 4365 005	3-15/16 x 10-7/8 x 23-27/32	3 lb. 5 oz.	

#### 3. ACCESSORIES REQUIRED BUT NOT SUPPLIED.

The following table lists the accessories required to complete an installation.

Quantity per Equipment	Name of Unit	Required Characteristics
	Primary Power Supply	
	Antenna	Fixed aircraft, ranging from 17 feet to 40 feet in length
	Headsets	
	Junction Box	





## GENERAL DESCRIPTION

(Cont.)

Quantity per Equipment	Name of Unit	Required Characteristics
	Jack Box	
	Associated Radio Transmitter	

### 4. PURPOSE OF EQUIPMENT.

The Model 51H-3 Receiver has been designed for installation in all types of aircraft. The purpose of the equipment is to provide reliable, preset, multi-channel, voice, cw, and mcw, pilot or radio operator controlled reception.

### 5. FREQUENCY RANGE.

1500 to 18,500 kc

This equipment is capable of receiving signals on any frequency within the range 1500 kc to 18,500 kc. The input circuit of the receiver has been designed to operate satisfactorily from a fixed aircraft antenna that is between 17 feet and 40 feet in length.

### 6. AUDIO OUTPUT CHARACTERISTICS.

The audio output is consistent at 500 milliwatts maximum with avc and noise limiter action. With r-f inputs of 10 to 10,000 microvolts, 30 per cent modulated, the output will contain 15% or less distortion. The audio response does not vary more than plus or minus 3 db relative to the response at 1000 cps for modulation frequencies of 300 to 4000 cps. The maximum attenuation is attained below 300 cps and above 4000 cps. The low pass filter provided for cw reception is down 30 db or more at 1600 cps from 1200 cps reference frequency and within 3 db from 1200 cps to 360 cps.

### 7. TYPES OF RECEPTION.

Voice, cw or mcw signals may be received with this equipment. A control on the front panel of the receiver permits the selection of the type of reception. This control is designated CW-MCW-CAL and should be operated to the





Figure 1-2 Type 51H-3 Receiver Unit





## GENERAL DESCRIPTION

MCW-CAL position when it is desired to receive voice or mcw signals. When voice modulated or mcw reception is selected, the beat frequency oscillator circuit is disabled, the avc circuit is connected so as to be operative and a variable "T" pad is used to control the input to the headphones. If cw reception is selected, the avc is partially disabled, the "T" pad is disconnected from the audio output circuit, and a potentiometer connected in the cathode circuit of the r-f amplifier and first and second i-f amplifier tube circuits, is used to control the gain. Both "T" pad and potentiometer are operated by the volume control.

### 8. SUCCESSFUL OPERATING LIMITS.

#### a. TEMPERATURE.

-40°C to +60°C (-40°F to +140°F)

This equipment is designed to operate at temperatures within range of -40° C to +60° C (-40° F to +140° F). At temperatures below -40° C (-40° F), a 20 minute warm-up period in still air should be allowed before making any adjustments or operating the channel selecting mechanism.

#### b. ALTITUDE.

40,000 feet.

This equipment will operate satisfactorily up to an altitude of 40,000 feet above sea level.

#### c. DISTANCE.

The distance limits of this receiving equipment will be determined by the conditions existing at the time of operating (day or night). The interference, time of operating, frequency and many other conditions will be the limiting factors. The required performance will be obtained under normal conditions encountered in aircraft radio operation.

### 9. POWER SOURCE REQUIREMENTS.

2.75 Amperes (Normal)

This equipment has been designed to operate from a 26.5 volt d-c supply. A variation of the voltage of plus or minus 10% will not materially affect the operation of the equipment. The current drain does not exceed 2.75 amperes d-c during reception after warm-up, 10 amperes during operation of the channel se-





## GENERAL DESCRIPTION

lecting mechanism, or 3.5 amperes during warm-up of the equipment at the lowest ambient temperature. Dynamotor starting surge is not included in the above figures. Dynamotor starting surge is approximately 15 amperes.

### 10. TYPE OF CONTROL.

*Manual or electrical.*

The tuning controls located on the front panel operate all preselection and conversion oscillator circuits of the receiver. Appropriate dials, calibrated in frequency, are associated with these controls to indicate the frequency to which the receiver is tuned. The controls may be operated either manually or electrically. This equipment employs the AUTOTUNE system of channel selection. Ten frequency channels may be manually selected and the controls locked. The controls may then be repositioned electrically to any one of the ten channels by operating the channel selecting switch on the front panel of the equipment.

### NOTE

The last operator that rotates his power ON-OFF switch to the ON position will have control of the equipment.

### 11. ANTENNA.

This equipment is designed to operate on an antenna which is also used for transmission. The transmitter used with this receiver should have a suitable antenna change over relay, which will ground the receiver antenna connection during transmission.





Figure 1-3 502 4365 005 Shock Mounting Base





## GENERAL DESCRIPTION

A spring type binding post, located near the upper edge of the front panel, provides the antenna connection for the equipment.

A spring type binding post, located near the lower edge of the front panel, provides the ground connection for the equipment.

### 12. MECHANICAL AND ELECTRICAL CHARACTERISTICS.

#### a. MECHANICAL DESCRIPTION.

(1) RADIO RECEIVER, DYNAMOTOR AND MOUNTING BASE. - The receiver and dynamotor power supply are contained in a single cabinet. The receiver cabinet has been designed to mount on a detachable shock reducing base. The base is designed to be installed as an integral part of the aircraft. The two main sections of the mounting base are held apart by live rubber cushions. It is only necessary to have access to the front of the equipment in order to fasten the unit to or remove the unit from the mounting base. The equipment may be fastened to or loosened from the mounting base by tightening or loosening two wing nuts on the front of the equipment. A multiterminal receptacle is mounted on the rear of the receiver chassis. The plug on the mounting base makes all of the electrical connections to the equipment except the antenna connections when the equipment is fastened to the mounting base. In addition to the shock reducing base on the receiver, a spring and rubber cushioned base is attached to the dynamotor to prevent the vibration that is caused by operation of the dynamotor, affecting the operation of the receiver. The installation section of this handbook gives the procedure to be followed for the mounting of the base and receiver.

No external equipment except an antenna, a set of headphones and a 26.5 volt d-c power source are necessary to complete the installation for panel control. If it is desired to control the receiver from a position some distance from the installation, additional controls are necessary. These controls are duplicates of the controls that are mounted on the receiver panel. Any number of remote control positions may be used with this equipment by connecting the controls at the remote position in parallel with those mounted on the receiver panel.

This receiver is equipped with the AUTOTUNE method of frequency selection. The AUTOTUNE system is an electrically controlled means of mechanically repositioning adjustable elements such as tap switches, variable capacitors and variable inductors to predetermined settings. Any combination of these items may be tuned to any one of several frequency channels by use of this system. In this particular equipment ten frequency channels are available. Any one of these ten frequency channels may be selected by





## GENERAL DESCRIPTION

operating a switch on the receiver panel. The AUTOTUNE system will operate to select the frequency channel in a period that will not exceed six seconds at room temperature and with a normal supply voltage (26.5 v). Lower temperature or lower source voltage or a combination of both will result in an increase in the time necessary to shift frequency channels. The AUTOTUNE may be cycled as many as four times per minute without serious heating of the motor or relays. The accuracy of repositioning is of a very high order and is not seriously affected by the wear, humidity or temperature changes. No tools are necessary for the adjustment of the AUTOTUNE mechanism. Refer to Section III, Paragraph 2. c. (1). Adjustments, for the procedure to be followed when changing a frequency channel.

Every effort has been made in the design of this equipment to reduce to a minimum the time that is required for the repair or replacement of components within the receiver. All components are accessible either from the sides or bottom when the receiver is removed from the cabinet. The components in assemblies that could not be mounted on accessible portions of the receiver chassis have been built into sub units that plug into receptacles that are mounted on the main receiver chassis. The four units that may be removed from the main assembly are the CFI unit, relay unit, line filter unit and the dynamotor unit. With the receiver cabinet removed, the fasteners on the dynamotor are accessible from the top of the receiver. All connections except the connection to the antenna are made to a multiterminal connector plug receptacle that is mounted on the rear of the mounting rack. Ground connections are made through the connector plug. The connector plug on the receiver is inserted into the plug receptacle when the receiver is secured in place on the mounting rack.



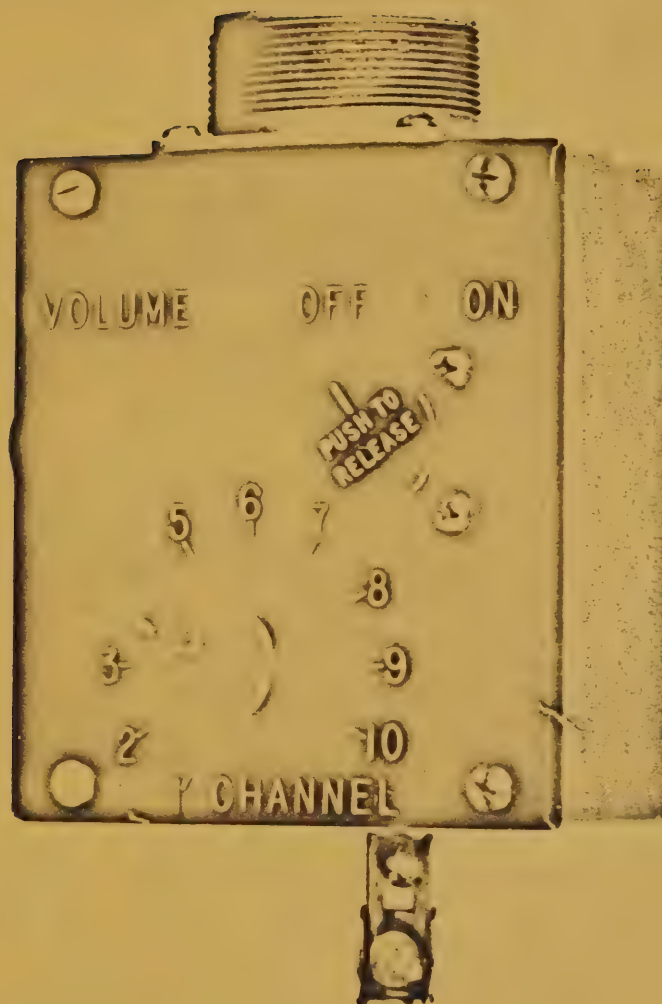


Figure 1-4 Type 314P-3 Remote Control Unit.





## GENERAL DESCRIPTION

b. ELECTRICAL DESCRIPTION. - The receiver employs a superheterodyne circuit and will receive cw and amplitude modulated voice and mcw signals. All of the tube heaters and a dynamotor operate from the 26.5 volts d-c power source. The dynamotor furnished high voltage for the receiving tubes.

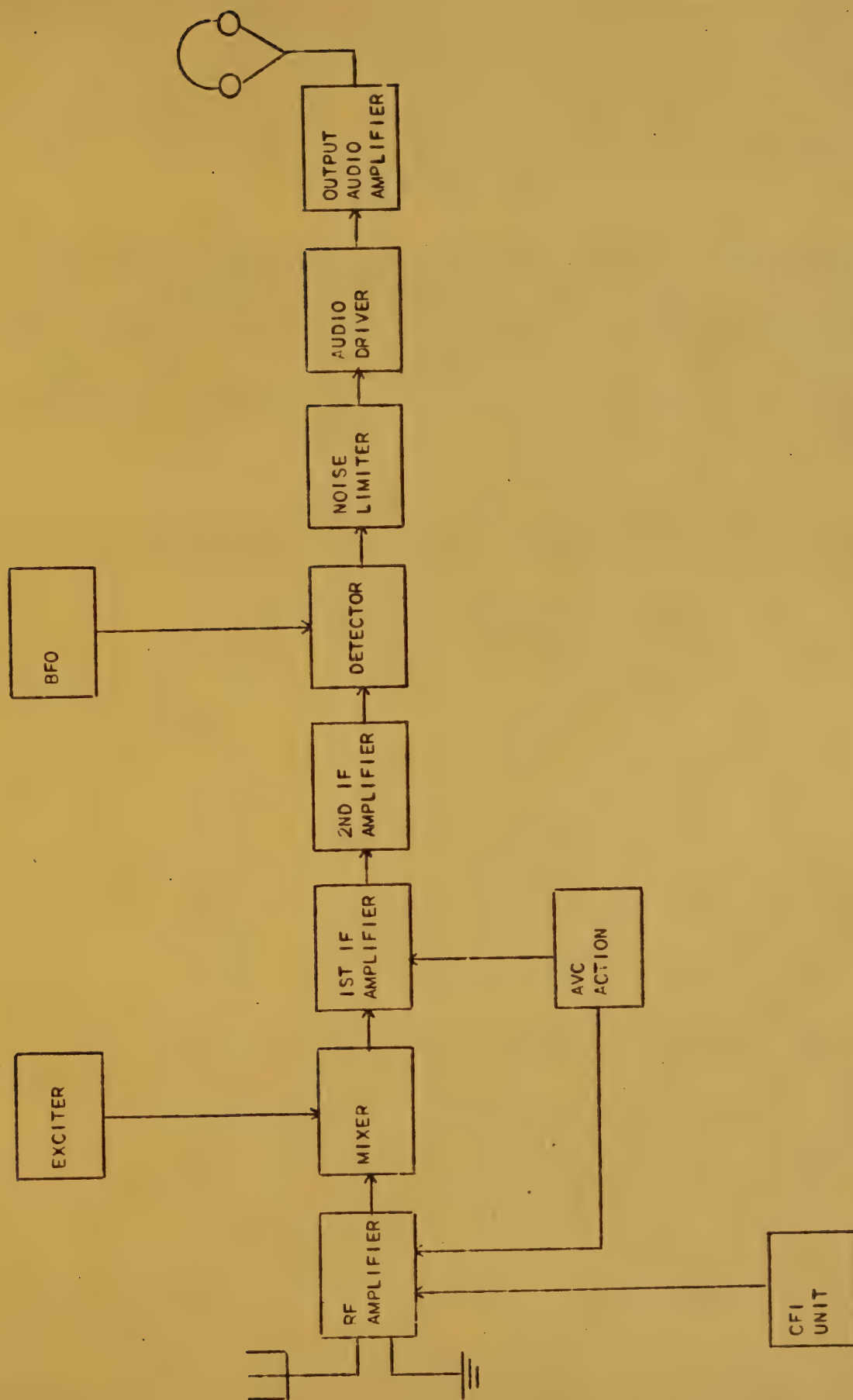
(1) R-F AND I-F AMPLIFIER CIRCUITS. - The superheterodyne circuit employs one stage of r-f amplification and two stages of i-f amplification. The i-f transformers are variable and will tune to frequencies in the range 450 kc to 550 kc. The variable characteristic of these transformers is only used during the calibrating of the receiver. When the receiver has been calibrated and it is desired to receive a transmitted signal, the i-f transformers are adjusted so that the i-f frequency, as used for reception, is 500 kc. For calibration and excitation purposes three oscillators have been incorporated in this receiver. The frequency of one oscillator circuit is determined by a 100 kc quartz crystal. Harmonics of this 100 kc signal are used when calibrating the receiver. During actual reception this oscillator is disabled by removing the plate and screen voltages from the oscillator tube. The frequency converting stage of this receiver is separately excited. One of the variable frequency oscillators is used to excite the mixer tube. This oscillator operates in the frequency range 2000 kc to 3000 kc and a frequency multiplier circuit is used to obtain the higher frequency excitation voltages. The remaining oscillator tube is essentially a beat frequency oscillator, but is also used during the calibration of the receiver. The output of this oscillator is in the frequency range 450 kc to 550 kc. When voice modulated or mcw signals are being received, the beat frequency oscillator circuit is disabled by removing the plate and screen voltage from the oscillator tube. Both of the variable frequency oscillators are precision built, mechanically and electrically, and their output is very stable under extreme conditions of humidity and temperature change.

(2) DETECTOR, AVC, NOISE LIMITER AND AUDIO AMPLIFIER CIRCUITS. - The detector circuit employs a fixed crystal detector unit. Two tubes, a dual diode and a dual triode, are necessary for the noise limiter. The dual triode is a balancer tube while the dual diode functions as the noise limiter tube. A dual triode is used to supply AVC voltage, one section of the dual triode is used in a trigger circuit while the other section is used to supply the AVC voltage. Two stages of audio amplification provide ample output for the operation of headphones.

(3) POWER SUPPLY CIRCUITS. - The tube filaments are connected in series parallel across the power source. The relay coils are energized by the power source. A plug-in dynamotor unit furnished the high voltage to the tubes. The motor section of the dynamotor operates from the 26.5 volt d-c power source.









## GENERAL DESCRIPTION

(4) REMOTE CONTROL CIRCUITS. - This equipment has facilities for connection of a remote control unit for remote power control and remote selection of receiving channels. The remote circuits should be similar to the circuits within the receiver. Any number of remote control units may be used since only one remote control can have control of the equipment at one time, providing the remote power switch is identical to the power switch in the receiver. The power switch (ON-OFF) in the receiver is a special switch which can be turned off manually or by an electrical impulse. The electrical impulse is furnished by the remote control desiring control over the equipment.





## SECTION II

### THEORY OF OPERATION

#### 1. MECHANICAL CHARACTERISTICS.

a. GENERAL. - The Type 51H-3 receiver is constructed in such a fashion that servicing can be accomplished with a minimum of effort. Plug-in units are employed where the use of such units would be of advantage. The CFI unit, the relay unit, the dynamotor unit and the filter unit are all plug-in units. The dynamotor unit is removed by removing the locking wires and disengaging the slide fasteners after which the dynamotor can be pulled straight up and out of the connector. Connections to the CFI, lfo and hfo units are by plug connectors which can be removed without the use of tools. The actual removal of the units require the use of tools, however. Since the procedure is important, refer to the MAINTENANCE section of this book for details on removing those units.

#### b. AUTOTUNE MECHANISM.

(1) GENERAL. - The Autotune system consists of a group of positioning mechanisms. The positioning mechanisms are connected to tuning elements within the equipment. Each mechanism is provided with a tuning knob so that the elements may be adjusted manually. Each positioning mechanism provides precise angular setting of the tuning element with which it is associated. The position of the tuning element with respect to the mechanism is readily adjustable and the setting for each control is entirely independent of the other controls. Locking bars, located on each tuning dial, lock the tuning element to the mechanism for each predetermined setting of the control.

The accuracy of positioning of the Autotune system is of a very high order. Each setting is inherently independent of wear, backlash, alignment, line voltage, etc. The accuracy of resetting of the tuning elements is comparable to that obtainable with vernier manual controls. All parts are machined within close limits and although operation is most precise there are no delicate adjustments or fragile mechanisms.

The Autotune system that is employed in this equipment consists of a motor, a singleturn unit, a multiturn unit, a control unit, a line shaft, drive gears and the necessary electrical control circuit components. The singleturn and multiturn units are provided with tuning knobs to permit the manual adjustment of the receiver circuit elements with which the units are associated. If given a reasonable amount of care and attention the mechanism will give long periods of trouble free service. Refer to the MAINTENANCE section of this Handbook.

In operation, a channel is selected by the channel selector switch which completes the circuit to the control unit. The control unit is the mechanism which sets the motor and the Autotune elements in motion and selects the right combination of mechanical sequence which will end up with the Autotune units



## THEORY OF OPERATION

positioned for the channel selected. After the control unit has functioned as just mentioned, the Autotune units connected to the tuning elements are rotated and stopped at the precise position to which they were pre-set. The control unit completes the operation by turning the motor and associated apparatus off. The following paragraphs give a detailed functional description of the Autotune system. The numbers appearing under the heading "Identifying Number" and "Operates On" refer to the numbers that are used to identify the parts on the illustrations.

### (2) CONTROL UNIT. (See Figure 2-1.)

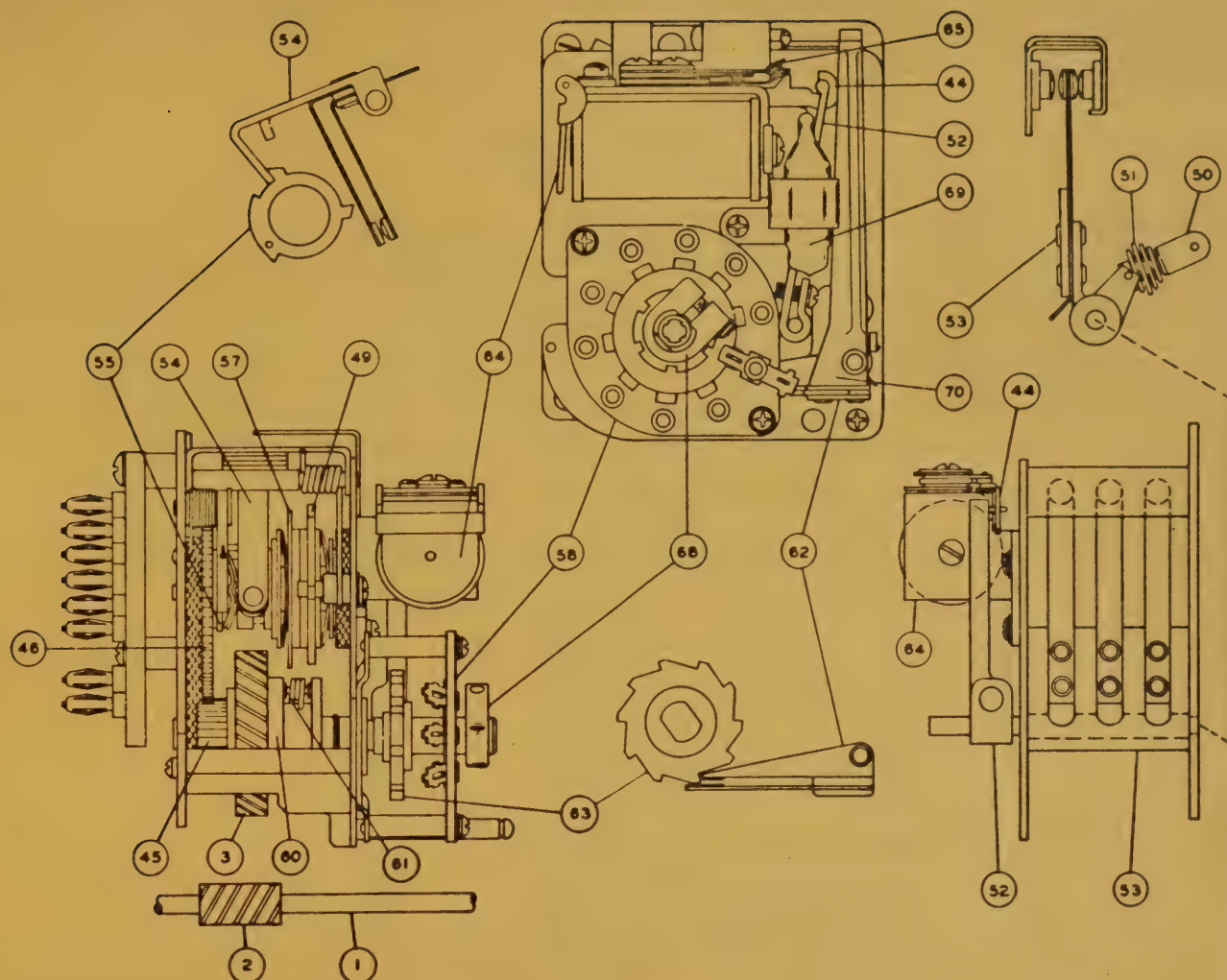
(a) BREAKER CAM (63) AND SEEKING SWITCH (58). - The seeking switch has ten switch contacts, one for each of the ten available frequency channels. Selection of any channel will result in the seeking switch rotating until the switch rotor reaches an open contact. The open contact will correspond to the channel that was selected. The rotation of the seeking switch is in a counter-clockwise direction due to the ratchet drive. The switch does not rotate during the last half of the Autotune cycle. The breaker cam is used for fine adjustment of the seeking switch.

<u>Functional Sequence Number</u>	<u>Identifying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
<u>Timing Switch Cam</u>			
1	(1)	Line Shaft	(2)
2	(2)	Drive Worm	(3)
3	(3)	Worm Gear	(60)
4	(60)	Seeking Switch Ratchet Dog	(61)
5	(61)	Seeking Switch Ratchet Tooth	(63)
6	(63)	Timing Switch Cam	(62)
<u>Seeking Switch</u>			
1	(1)	Line Shaft	(2)
2	(2)	Drive Worm	(3)
3	(3)	Worm Gear	(60)
4	(60)	Seeking Switch Ratchet Dog	(61)
5	(61)	Seeking Switch Ratchet Tooth	(58)
6	(58)	Seeking Switch	

(b) AUTOTUNE ROTOR CONTROL SWITCH (53) AND STARTING RELAY CONTACTS (65). - When the seeking switch has come to rest in the position that corresponds to the







KEY TO SYMBOLS FOR CONTROL UNIT, MULTITUNE UNIT AND SINGLETUNE UNIT

- |                                   |                                   |                                  |
|-----------------------------------|-----------------------------------|----------------------------------|
| 1. Line Shaft                     | 28. Home Stop Ring                | 50. Locking Arm Operating        |
| 2. Drive Worm                     | 29. Home Stop Pawl                | Clutch Arm                       |
| 3. Worm Gear                      | (29A-Pawl Heel)                   | 51. Locking Arm Operating        |
| 4. Slip Clutch Drive Gear         | (29B-Pawl Tail)                   | Clutch Arm Spring                |
| 5. Slip Clutch Idler Gear         | (29C-Pawl Toe)                    | 52. Locking Arm                  |
| 6. Slip Clutch Spur Gear          | 30. Stop Ring                     | 53. AUTOTUNE Motor Control       |
| 7. Slip Clutch Band Dog           | 31. Stop Ring Pawl                | Switch (S-109)                   |
| 8. Slip Clutch Band               | (31A-Pawl Heel)                   | 54. Faulty Operation Switch      |
| 9. Slip Clutch Drum               | (31B-Pawl Tail)                   | (S-108)                          |
| 10. Counter Drum Drive Gear       | (31C-Pawl Toe)                    | 55. Faulty Operation Switch Cam  |
| 11. Counter Drum Idler Gear       | 32. Pawl Spring                   | 56. Faulty Operation Switch      |
| 12. Counter Drum Spur Gear        | 33. Stop Ring Drum Lock           | Interlock Arm                    |
| 13. Planetary Drive Gear          | 34. Tuning Knob Shaft             | 57. Faulty Operation Switch      |
| 14. Planetary Stationary Gear     | 35. Tuning Drive Gear             | Interlock Clutch Cam             |
| 15. Counter Drum Planetary Gear   | 36. Tuning Drive Limit Spline     | 58. Seeking Switch (S-106)       |
| 16. Cam Drum Idler Gear           | 37. Tuning Idler Gear             | 59. Seeking Switch Adjuster      |
| 17. Cam Drive Gear Assembly       | 38. Tuning Spur Gear              | 60. Seeking Switch Ratchet dog   |
| 18. Cam Drum Spur Gear            | 39. Tuning Spur Gear Clutch       | 61. Seeking Switch Ratchet Tooth |
| 19. Cam Drum Ratchet Dog          | 40. Tuned Element                 | 62. Breaker Contacts (S-107)     |
| 20. Cam Drum Ratchet Tooth        | 41. Stop Bar                      | 63. Breaker Cam                  |
| 21. Cam Drum                      | 42. Stop Ring Drum Drive          | 64. AUTOTUNE Starting Relay      |
| 22. Counter Drum Slot Ring        | 43. Cam Drum Drive Gear           | Contacts                         |
| 23. Counter Drum Slot Ring Pawl   | 44. AUTOTUNE Motor Control Switch | 65. Locking Arm Operating        |
| (23A-Pawl Heel)                   | Lock                              | Clutch Spring                    |
| (23B-Pawl Tail)                   | 45. Locking Arm Drive Gear        | 67. Single Tooth Ratchet         |
| (23C-Pawl Toe)                    | 46. Locking Arm Spur Gear         | Assembly                         |
| 24. Counter Drum Home Stop Gear   | 47. Locking Arm Engage Collar     | 68. Seeking Switch Locking       |
| 25. Home Stop Pawl Operating Gear | 48. Locking Arm Operating Clutch  | Collar                           |
| 26. Pawl Lifting Toggle Lever     | Drum                              | 69. Neon Bulb (surge absorber)   |
| 27. Pawl Lifting Toggle           | 49. Locking Arm Operating Clutch  |                                  |
|                                   | Cam                               |                                  |

Figure 2-1 Autotune Control Unit Functional Diagram



## THEORY OF OPERATION

channel that has been selected the Autotune motor control switch is closed. The closing of the switch reverses the Autotune motor to complete the last half of the cycle. When the last half of the Autotune cycle is completed, the Autotune control switch is returned to the original position and the motor is stopped. With the switch in this position the Autotune motor is connected for forward rotation. The motor will operate when the next channel is selected and the energizing circuit of the motor is completed by the closing of the Autotune starting relay switch contacts.

<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(1)	Line Shaft	(2)
2	(2)	Drive Worm	(3)
3	(3)	Worm Gear	(45)
4	(45)	Locking Arm Drive Gear	(46)
5	(46)	Locking Arm Spur Gear	(49)
6	(49)	Locking Arm Operating Clutch	(50)
7	(50)	Locking Arm Operating Clutch Arm	(52) - (53)
8	(53)	Autotune Motor Control Switch	
9	(52)	Locking Arm	(44)
10	(44)	Motor Control Switch Lock	(65)
11	(65)	Autotune Starting Relay Contacts	

(c) FAULTY OPERATION SWITCH (54). - If the selector switch fails to find an open circuit within two revolutions, the faulty operation switch will close and energize the releasing coil of the ON-OFF switch. The energizing of the releasing coil will cause the switch to rotate to the OFF position to disable the equipment.

<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(1)	Line Shaft	(2)
2	(2)	Drive Worm	(3)
3	(3)	Worm Gear	(45)
4	(45)	Locking Arm Drive Gear	(46)
5	(46)	Locking Arm Spur Gear	(55)
6	(55)	Faulty Operation Switch Cam	(54)
7	(54)	Faulty Operation Switch	





## THEORY OF OPERATION

(3) **AUTOTUNE SINGLETURN UNIT.** (See Figures 2-2, 7-26, 7-27 and 7-28.) - The singleturn unit derives its name from the fact that it will mechanically position a tuning element that does not require more than 360 degrees of rotation. The unit includes a friction band type clutch for transmitting the driving torque to the positioning elements, a stop ring drum assembly, a pawl stack, a cam drum and the associated driving gears.

(a) **CAM DRUM DRIVE (21).** - The cam drum has ten slots, one for each of the ten channels, spaced 36° apart. Selecting any channel will result in the pawl corresponding to the channel dialed coming to rest in the proper slot. The rotation of the cam drum is in a counterclockwise direction only, due to the ratchet drive. The cam drum does not rotate during the last half of the Autotune cycle.

<u>Functional Sequence Number</u>	<u>Identifying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(1)	Line Shaft	(2)
2	(2)	Drive Worm	(3)
3	(3)	Worm Gear	(43) (9) (40)
4	(43)	Cam Drum Drive Gear	(16)
5	(16)	Cam Drum Idler Gear	(18)
6	(18)	Cam Drum Spur Gear	(19)
7	(19)	Cam Drum Ratchet Dog	(20)
8	(20)	Cam Drum Ratchet Tooth	(21)
9	(21)	Cam Drum	(31A)
	(31A)	Stop Ring Pawl Heel	

(b) **STOP RING DRIVE (30).** - There are ten stop rings on the stop ring stack, one for each of the ten channels. Keyed washers between stop rings permit each stop ring to rotate independently of all others when the stack is unlocked. Setting the tuned element and locking the stop ring stack at that setting will result in the tuned element returning to this same position when that channel is again selected. The stack of stop rings rotates both counterclockwise and clockwise until stopped by a stop ring pawl.

<u>Functional Sequence Number</u>	<u>Identifying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(1)	Line Shaft	(2)
2	(2)	Drive Worm	(3)
3	(3)	Worm Gear	(43) (9) (40)
4	(9)	Slip Clutch Drum	(8)









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<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
5	(8)	Slip Clutch Band	(7)
6	(7)	Slip Clutch Band Dog	(28)(30)
7	(28)	Home Stop Ring	(41)
	(30)	Stop Ring	(31C)
	(31C)	Stop Ring Pawl Toe	

(g) STOP RING PAWL (31). - When the stop rings are unlocked the stop ring pawl toes dropping into the stop ring slots hold the stop ring fixed while the tuned element is rotated for initial adjustment. When the tuned element has been set and the stop rings locked, the pawl toes, serve to stop the tuned element at the pre-set point. The pawl heels fall into the cam drum slots allowing the pawl spring to force the pawl toe into the stop ring slots.

<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
	(31)	Stop Ring Pawl	(30)
	(30)	Stop Ring	
	(40)	Tuning Element	

(4) AUTOTUNE MULTITURN UNIT. (See Figures 2-3, 7-29, 7-30 and 7-31.) - The multiturn unit mechanically positioning a tuning element requires more than 360 degrees of rotation. In this equipment, the multiturn unit may be required to complete as many as ten revolutions to position the tuning element. The unit includes a friction band type clutch for transmitting the driving torque to the positioning elements, a stop ring drum assembly, a pawl stack, a pawl toggle, a counter drum assembly, a cam drum and the associated driving gears.

(g) CAM DRUM DRIVE (21). - The cam drum has ten slots, one for each of the ten channels, spaced 36° apart. Dialing any channel will result in the pawl corresponding to the channel dialed coming to rest in the proper slot. The rotation of the cam drum is in a counterclockwise direction only, due to the ratchet drive. The cam drum does not rotate during the last half of the Autotune cycle.



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<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(1)	Line Shaft	(2)
2	(2)	Worm Gear Drive Worm	(3)
4	(3)	Cam Drum Idler Gear	(4)(16)
5	(17)	Cam Drum Idler Gear #2	(18)
6	(18)	Cam Drum Spur Gear	(19)
7	(19)	Cam Drum Ratchet Dog	(20)
8	(20)	Cam Drum Ratchet Tooth	(21)
9	(21)	Cam Drum	

(b) STOP RING DRIVE (30). - There are ten stop rings in the stop ring stack, one for each of the ten channels. When the Autotune unit is unlocked each stop ring is free to rotate independently of the others due to the presence of keyed washers between each ring. Setting the tuned element and locking the stop ring stack at that setting will result in the tuned element taking this same position when that channel is again selected. All stop rings rotate both counterclockwise and clockwise until stopped by a stop ring pawl.

<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(1)	Line Shaft	(2)
2	(2)	Drive Worm	(3)
3	(3)	Worm Gear	(4)(16)
4	(4)	Slip Clutch Drive Gear	(5)
5	(5)	Slip Clutch Idler Gear	(6)
6	(6)	Slip Clutch Spur Gear	(7)(40)
7	(7)	Slip Clutch Band Dog	(8)
8	(8)	Slip Clutch Band	(9)
9	(9)	Slip Clutch Drum	(30)
10	(30)	Stop Rings	(10)
	(10)	Counter Drum Drive Gear	

(c) COUNTER DRUM DRIVE (FAST). - The counter drum serves to select the revolution in which the stop ring is to be engaged by the stop ring pawl toe. Ten counter drum slot rings, one for each Autotune channel, are mounted on the counter drum shaft and separated by spacers that are keyed to the shaft. A wavy washer that is mounted on the shaft loads the stack of slot rings axially so that the rings can not easily be turned independently of the counter drum shaft. The position of any given counter drum slot ring is adjusted during the adjustment of the tuned element. At the instant the planetary drive gear





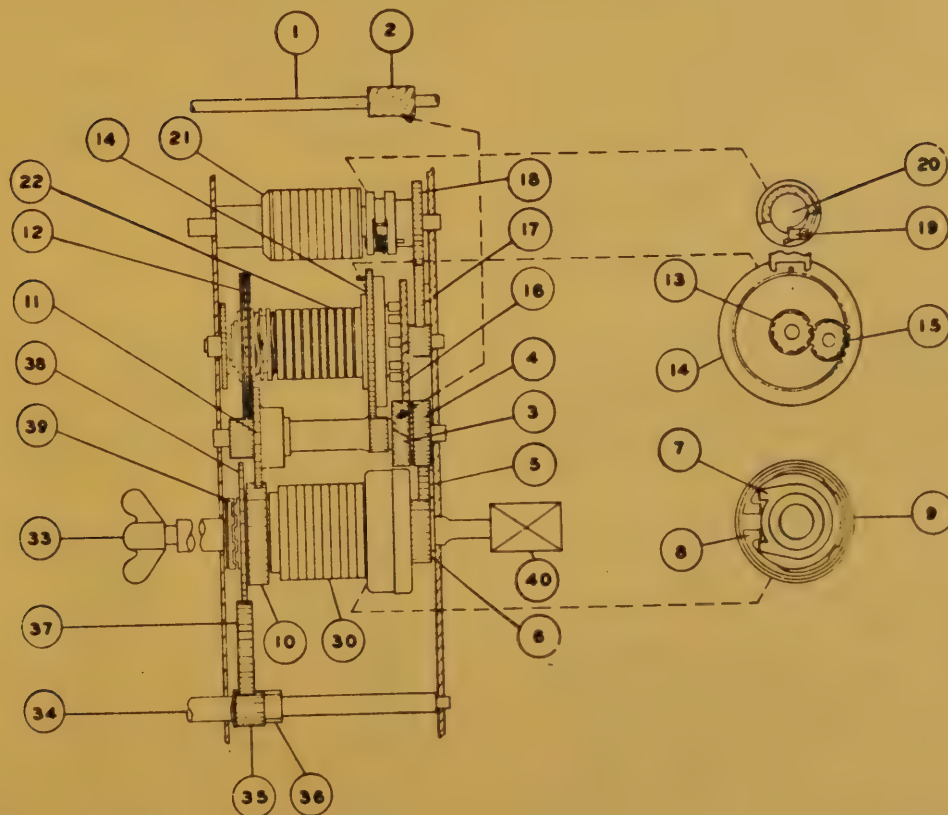
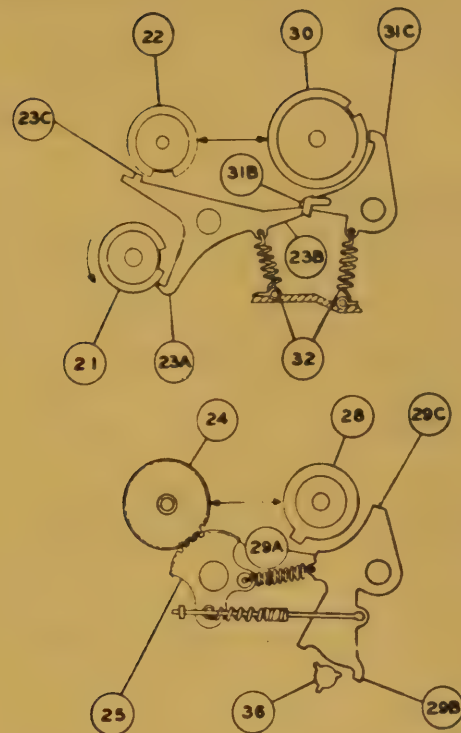
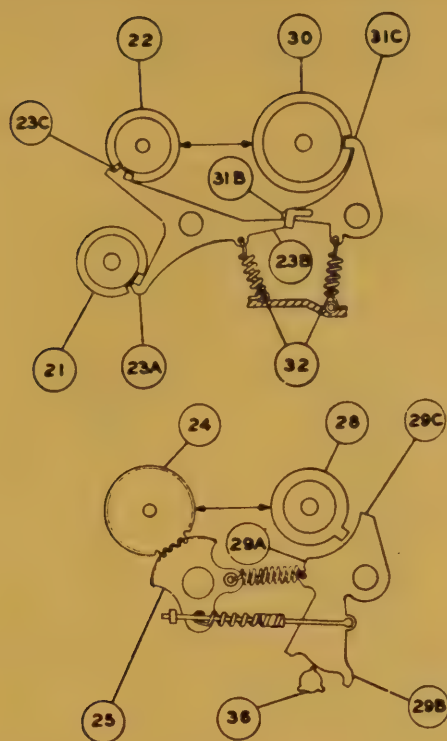


Figure 2-3 Multiturn Unit Functional Diagram



## THEORY OF OPERATION

changes direction of rotation, the planetary stationary gear is allowed to move the width of the planetary stationary gear pin slot and the counter drum planetary gear ceases to turn. The result is that at the limits of the counter drum rotation the counter drum rotates more rapidly.

<u>Functional Sequence Number</u>	<u>Identifying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(10)	Counter Drum Drive Gear	(11)
2	(11)	Counter Drum Idler Gear	(12) (13)
3	(12)	Counter Drum Spur Gear	(22)
3	(13)	Planetary Drive Gear	(14)
4	(14)	Planetary Stationary Gear	(22)
5	(22)	Counter Drum Slot Rings	

(d) COUNTER DRUM DRIVE (SLOW). - When the planetary stationary gear has traveled the width of the gear pin slot and ceases to turn, the counter-drum planetary gear is driven by the planetary drive gear. Since the shaft for the gear is fastened to the counter drum assembly, the drum is driven at a slower speed as the gear travels around the driving gear.

<u>Functional Sequence Number</u>	<u>Identifying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(10)	Counter Drum Drive Gear	(11)
2	(11)	Counter Drum Idler Gear	(13)
3	(13)	Planetary Drive Gear	(22)
4	(22)	Counter Drum Slot Rings	

(e) OPERATING THE STOP RING PAWLS. - The stop ring pawl tail is released by the counter drum slot ring pawl tail. At the moment of release, the pawl is actuated by the pawl spring causing the pawl toe to press against the stop ring and to drop into the stop ring slot, within one revolution of the stop ring drum. The above sequence of events positions the tuned element.

<u>Functional Sequence Number</u>	<u>Identifying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(21)	Cam Drum	(23A)
2	(23A)	Counter Drum Slot Ring Pawl Heel	(23B)
3	(23B)	Counter Drum Slot Ring Pawl Tail	(31)
4	(31)	Stop Ring Pawl	(30)
5	(30)	Stop Rings	





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(f) **TIMING.** - At the beginning of the Autotune cycle the cam drum rotates in a clockwise direction. The operation of the cam drum kicks the counter drum slot ring pawl heel from the stop ring slot and lifts the counter drum slot ring pawl toe from the counter drum slot ring. Because the cam drive gear assembly is rotating in a counterclockwise direction, the pawl lifting toggle is expanded by the pawl lifting lever which rides on the cam drive gear pins. The pawl lifting toggle, when expanded, prevents the pawls from dropping into the counter drum ring slots until the direction of rotation is reversed. Upon reversal, the pawl lifting lever is moved in the opposite direction and lowers the toggle, allowing the counter drum slot ring pawl toes to drop. Because the cam drum is driven by a single tooth ratchet, the drum cannot be rotated in a counterclockwise direction. When the counter drum slot ring pawl toe drops into place, the counter drum slot ring pawl rides on the counter drum ring and drops into the slot. The operation of the counter drum slot ring pawl toe, operates counter drum slot ring pawl tail. The counter drum slot ring tail operates the stop ring pawl tail and permits the stop ring pawl toe to engage the stop ring slot.

<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(22)	Counter Drum Slot Rings	(23C)
2	(23C)	Counter Drum Slot Ring Pawl Toe	(23B)
3	(23B)	Counter Drum Slot Ring Pawl Tail	(31)
4	(31)	Stop Ring Pawl	(30)
5	(30)	Stop Rings	(40)
6	(40)	Tuning Element	

(g) **OPERATION OF THE PAWL LIFTING TOGGLE.** - The pawl lifting toggle is located directly below the tails of the counter drum pawls. The toggle base is rigidly attached to the control unit frame. The upper part of the toggle, which lifts the pawl tails, pivots on an arm fastened to the counter drum pawl shaft. The center hinged sections of the pawl lifting toggle is operated by pins on the cam drive gear assembly through the pawl lifting lever. When the counter drum is rotated in a clockwise direction, the pawl lifting lever moves in the direction which collapses the toggle allowing the counter drum pawls to fall into the counter drum ring slots. When the counter drum is rotated in a counterclockwise direction the pawl lifting lever moves in the opposite direction which straightens the toggle under the counter drum pawls preventing the pawls from dropping into the counter drum ring slots.



## THEORY OF OPERATION

<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(17)	Cam Drive Gear Assembly	(26)
2	(26)	Pawl Lifting Lever	(27)
3	(27)	Pawl Lifting Toggle	(22)
4	(22)	Counter Drum Kings	

(h) STOP RING DRUM LIMIT DRIVE. - The counter drum home stop gear is driven by a limiting ratchet within the counter drum. When the counter drum has rotated in a clockwise direction to the predetermined limit, the ratchet drives the counter drum home stop gear in a clockwise direction. The counter drum home stop gear operates the home stop pawl operating gear which in turn operates the home stop pawl. This pawl limits the counterclockwise rotation of the home stop ring. Conversely, rotation of the counter drum home stop gear in the counterclockwise direction limits the rotation of the home stop ring in a clockwise direction.

<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1		Counter Drum	(24)
2	(24)	Counter Drum Home Stop Drive Gear	(25)
3	(25)	Home Stop Pawl Operating Gear	(29)
4	(29)	Home Stop Pawl	(28)
5	(28)	Stop Ring Drum Home Stop Ring	

(i) TUNING DRIVE. - Half of the tuning spur gear clutch is rigidly attached to the tuning spur gear. When this clutch is not engaged, the tuning gear is independent of the Autotune system and does not rotate with it. When the lock is loosened, the clutch is engaged and tuning spur gear is coupled to the stop ring drum shaft. The tuning drive gear spline limits the rotation of the tuning drive gear by engaging the stop ring drum home stop pawl tail.





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<u>Functional Sequence Number</u>	<u>Identi- fying Number</u>	<u>FUNCTIONAL DESCRIPTION OF PART</u>	<u>Operates on Number</u>
1	(34)	Tuning Knob	(35)
2	(35)	Tuning Drive Gear	(37) (36)
3	(37)	Tuning Idler Gear	(38)
4	(38)	Tuning Spur Gear	(39)
5	(39)	Tuning Spur Gear Clutch	(40)
6	(40)	Tuning Element	
	(36)	Tuning Drive Gear Spline	

## 2. ELECTRICAL CHARACTERISTICS.

### a. AUTOTUNE ELECTRICAL DETAILS. (See Figure 2-4.)

B-101, MOTOR. - The Autotune motor operates from 26.5 volt d-c power source and is controlled by the motor starting relay, K-103, and the motor control switch, S-109. The components employed in the Autotune control circuit and the functions of each are given below:

K-103, MOTOR STARTING RELAY. - The motor starting relay is energized by the circuit through the contacts of the primary power control relay, the contacts of the circuit seeking and timing switches, the contacts of the channel selector switch and the contacts of the ON-OFF switch to ground.

S-109, MOTOR CONTROL SWITCH. - The motor control switch is operated mechanically by the rotation of the motor. Indirectly, the motor control switch is controlled electrically by the motor starting relay. A locking arrangement on the motor starting relay allows the control switch to be operated mechanically only, at specific times.

S-105, CHANNEL SELECTOR SWITCH. - If the ON-OFF switch is in the ON position, the operation of the channel selector switch to a new position will operate the motor starting relay by completing the circuit thru the coil of the relay to ground. The operation of the motor starting relay energizes the motor and begins the Autotune cycle. Any one of ten different frequency channels may be selected by the operation of this switch.

S-106, CIRCUIT SEEKING SWITCH. - The circuit seeking switch is a part of the Autotune control unit and is driven by the motor. For an instant during each of the ten switch positions, the circuit seeking switch is disconnected from ground by the breaker contacts of the timing switch, S-107. The breaker contacts cam is attached to the same shaft as the circuit seeking switch rotating element. The operation of the motor start relay, mechanically locks



PLATE #1

- A frequency channel has been selected by manually operating the CHANNEL selector switch, S-108.

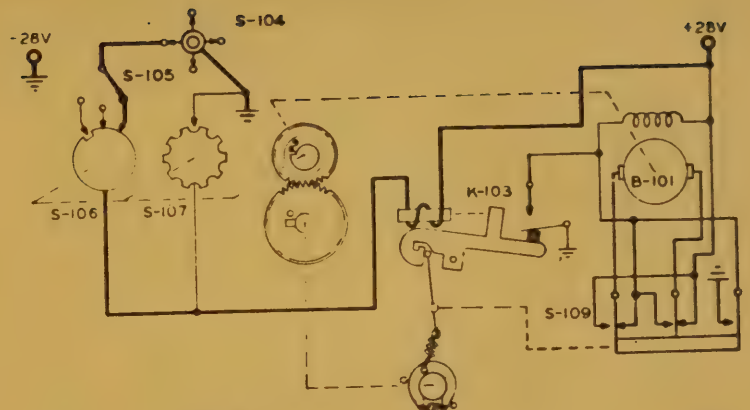


PLATE #2

- Relay K103 has operated as the result of the completing of the energizing circuit through switch S-108.
- The contacts of relay K103 have closed to complete the Autotune motor energizing circuit.
- The armature of the motor has not begun to rotate.
- The relay locking arm has dropped into the locking position.

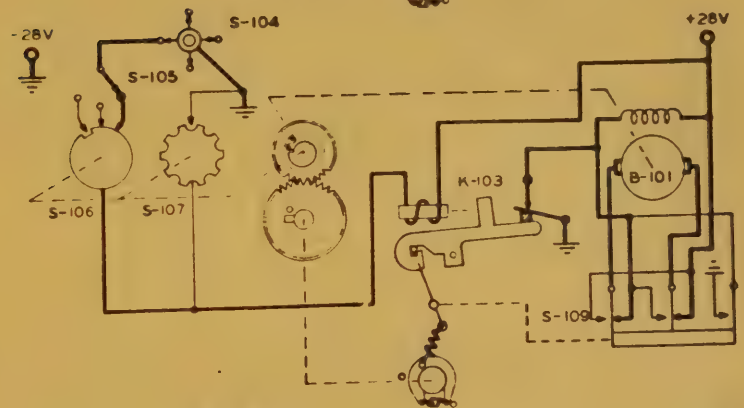


PLATE #3

- The armature of the motor has rotated counterclockwise.
- Seeking switch S106 and breaker cam (S107) have rotated one-half of a revolution in a counterclockwise direction.
- Relay K103 is still operated.

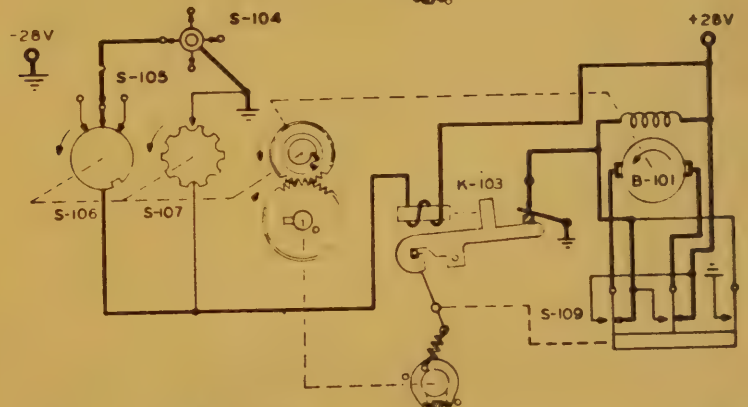


PLATE #4

- The motor armature is still rotating in a counterclockwise direction.
- The seeking switch, S106, and the breaker cam (S107) have continued to rotate counterclockwise and have reached the position that breaks the energizing circuit of relay K103.
- Relay K103 is held closed by the relay locking arm.
- The pin on the drive gear approaches the pin on the clutch which drives the actuating arm of both S109 and the K103 locking arm.

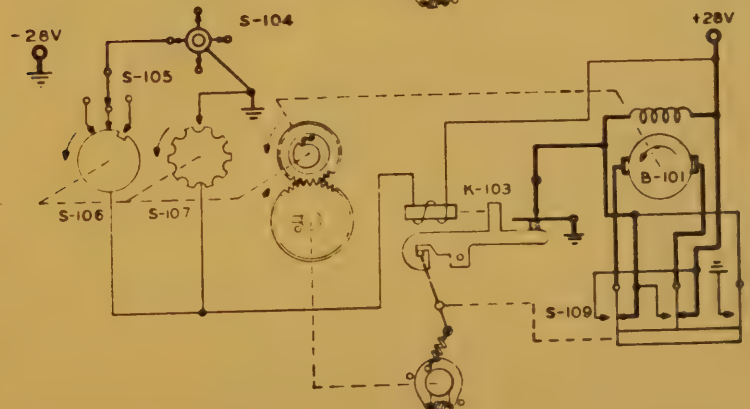


Figure 2-4 Autotune Sequence of Operation (Sheet 1 of 2 Sheets)





PLATE #5

- The motor armature is still rotating in a counterclockwise direction.
- Seeking switch, S106, and the breaker cam (S107) have continued to rotate counterclockwise and have reached the position that closes the energizing circuit of relay K103.
- The clutch has continued to operate and has compressed the spring which drives the actuating arm of S109 and the K103 locking arm. The locking arm has unlocked K103.

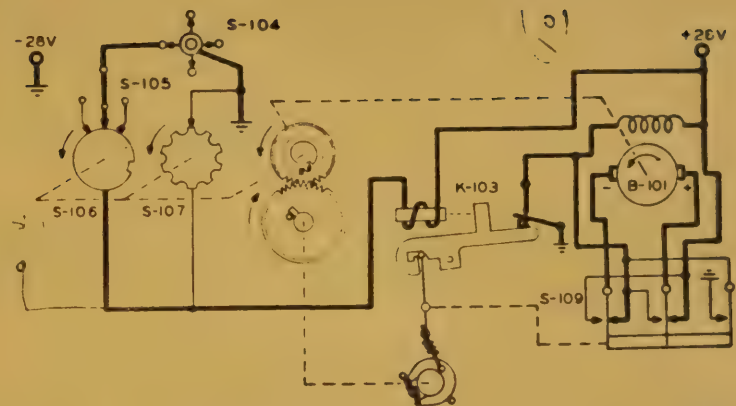


PLATE #6

- Seeking switch, S106, and the breaker cam, S107, have reached the position that breaks the energizing circuit of K103.
- Relay K103 opens and causes the motor armature to cease counterclockwise rotation.
- The compressed spring on the locking arm operating clutch operates the motor reversing switch S109, to the reverse position.
- The motor armature begins to rotate in a clockwise direction.

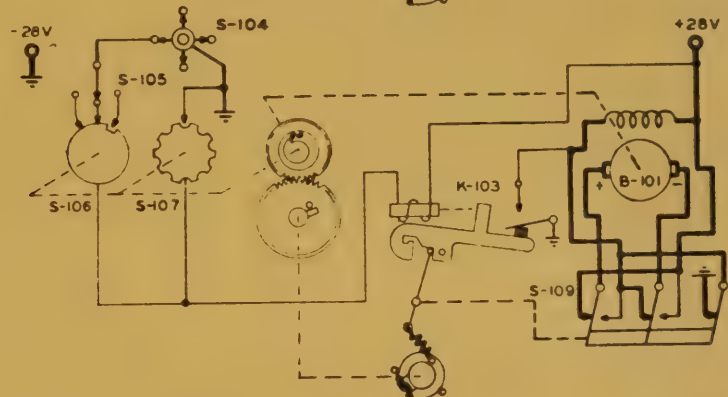


PLATE #7

- The motor armature is still operating in a clockwise direction.
- Reversing switch S109 is still held in place by locking arm operating clutch arm spring.

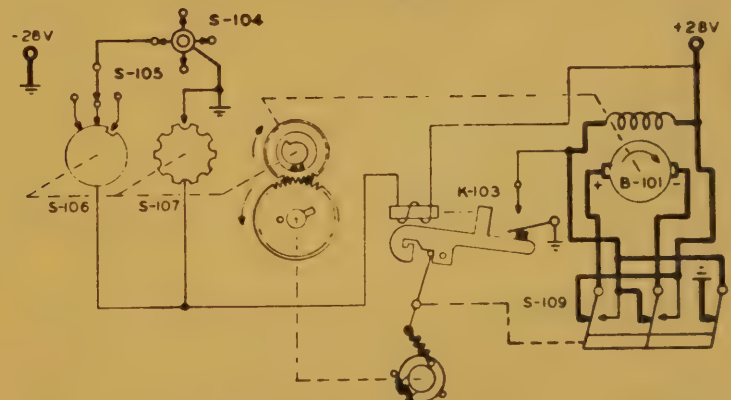


PLATE #8

- The pin on the drive gear engages the pin on the clutch, which drives the actuating arm of both S109 and the K103 locking arm, and restores S109 to the original position.
- The motor is de-energized and completes clockwise rotation.
- The Autotune cycle is completed and the system is ready for the selecting of a new frequency channel.

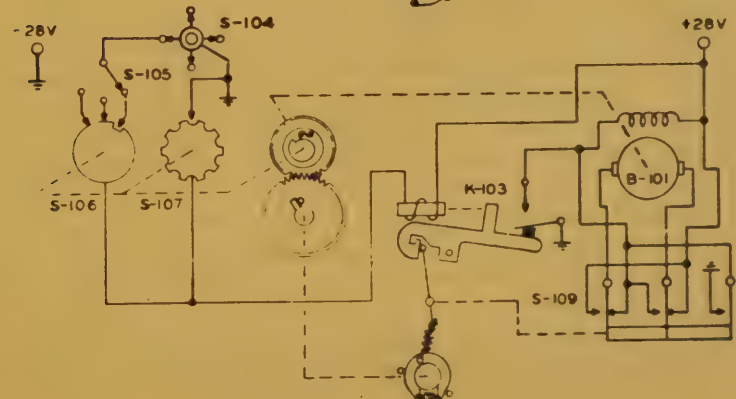


Figure 2-4 Autotune Sequence of Operation (Sheet 2 of 2 Sheets)



## THEORY OF OPERATION

a motor ground completing circuit into place and prevents the seeking switch and the breaker contacts from finding and opening the circuit that is selected by the channel selector switch until after the rotation of the motor unlocks the motor start relay.

S-107, TIMING SWITCH. - The contacts are momentarily opened ten times as the circuit seeking switch rotates thru 360 degrees. The timing switch contacts are opened by the operation of a cam that is attached to the same shaft as the rotor of the circuit seeking switch. After the rotation of the motor unlocks the motor start relay and substitutes the seeking switch circuit for the motor ground completing circuit through the contact on the start relay, the timing switch contacts and the circuit seeking switch find the open ground circuit within one revolution. During this interval the open segment of the circuit seeking switch has found the circuit that was selected and the timing switch contacts open. The opening of the timing switch contacts breaks the energizing circuit of the motor start relay. The motor start relay returns to the normal (unoperated) position, allowing the motor control switch to be mechanically positioned for the reversing of the motor. When the motor has reversed the required distance, the motor control switch is mechanically operated to the original position, removing the motor energizing circuit and stopping the motor.

S-108, FAULTY OPERATION SWITCH. - This switch is operated if the motor fails to reverse as a result of the faulty operation of the channel selector switch, the circuit seeking switch or the timer switch breaker contacts of the motor control switch. The operation of this switch energizes the coil of ON-OFF switch and causes the ON-OFF switch to be rotated to the OFF position, disabling the entire equipment.

b. SEQUENCE OF OPERATION. - The sequence of operation is explained fully in Figure 2-4.

c. PRIMARY POWER CIRCUIT. (See Figure 2-5.) - This equipment has been designed to operate from a 26.5 volt d-c power source. All of the vacuum tubes that are used in the equipment are of the 12.6 volt heater type. The heaters of the tubes are connected in series parallel across the power source. The resistance of the filter chokes and leads to the tube heaters reduce the voltage to the correct value for application to the series-parallel connected heaters.

Refer to Figure 2-5. With the connections from the power source made to terminals 9, and 17 of connector plug P-101 (terminals 9 negative and terminals 17 positive), complete control of application of voltage to the equipment is held by the ON-OFF switch. The operating of the ON-OFF switch, either the panel switch or a remote switch, to the ON position energizes the primary power control relay, K-101. The operation of the primary power control relay applies





## THEORY OF OPERATION

voltage to all vacuum tube heaters, to the two dial lamps and to the motor section of the dynamotor and connects one side of all of the relay coils to the positive side of the power source. The ON-OFF switch may be released either manually or electrically. Identical power control switches are used on the equipment control panel and on the remote control units. The switch contains a solenoid and when the solenoid is energized, the switch is released. The grounding end of the solenoid that is located in the equipment control panel ON-OFF switch is brought out to terminal 4 on connector plug P-101. When the ON-OFF switch is in the ON position, the grounding of the terminal 4 will release the switch and a spring will return the mechanism to the OFF position. All ON-OFF switches that are used with any one installation are connected in parallel and the operating of any one switch to the ON position will energize the solenoid of the ON-OFF switch that is in the ON position.

The following table lists the reference symbols and functions of the control relays:

### Reference Symbols

### Functions

K-101  
PRIMARY CONTROL RELAY

(Operated by ON-OFF switch)  
When the ON-OFF switch is rotated to the ON position, the primary power control relay K-101 energizes the dynamotor.

K-102  
RECEIVER DISABLING RELAY

When the Autotune motor is operating the contacts of the relay K-102 are opened removing the ground circuit from terminal 4 of T-101.

K-103  
AUTOTUNE STARTING RELAY

Selecting a channel with switch S-105 operates relay K-103 starting Autotune motor by grounding one side of the field to complete the circuit.

K-501  
MCW-CW, CAL RELAY

MCW-In the MCW position the cw-avc is grounded and plate voltage is removed from the bfo.

CW, CAL-In the CW-CAL position the cw-avc is operative and plate voltage is applied to the bfo.

K-502  
CAL - RECEIVE

CAL-When the relay is in the CAL position, plate voltage is applied to the CFI unit, cw ground is connected, ant circuit is grounded, and the CFI output voltage is connected to the receiver r-f input.



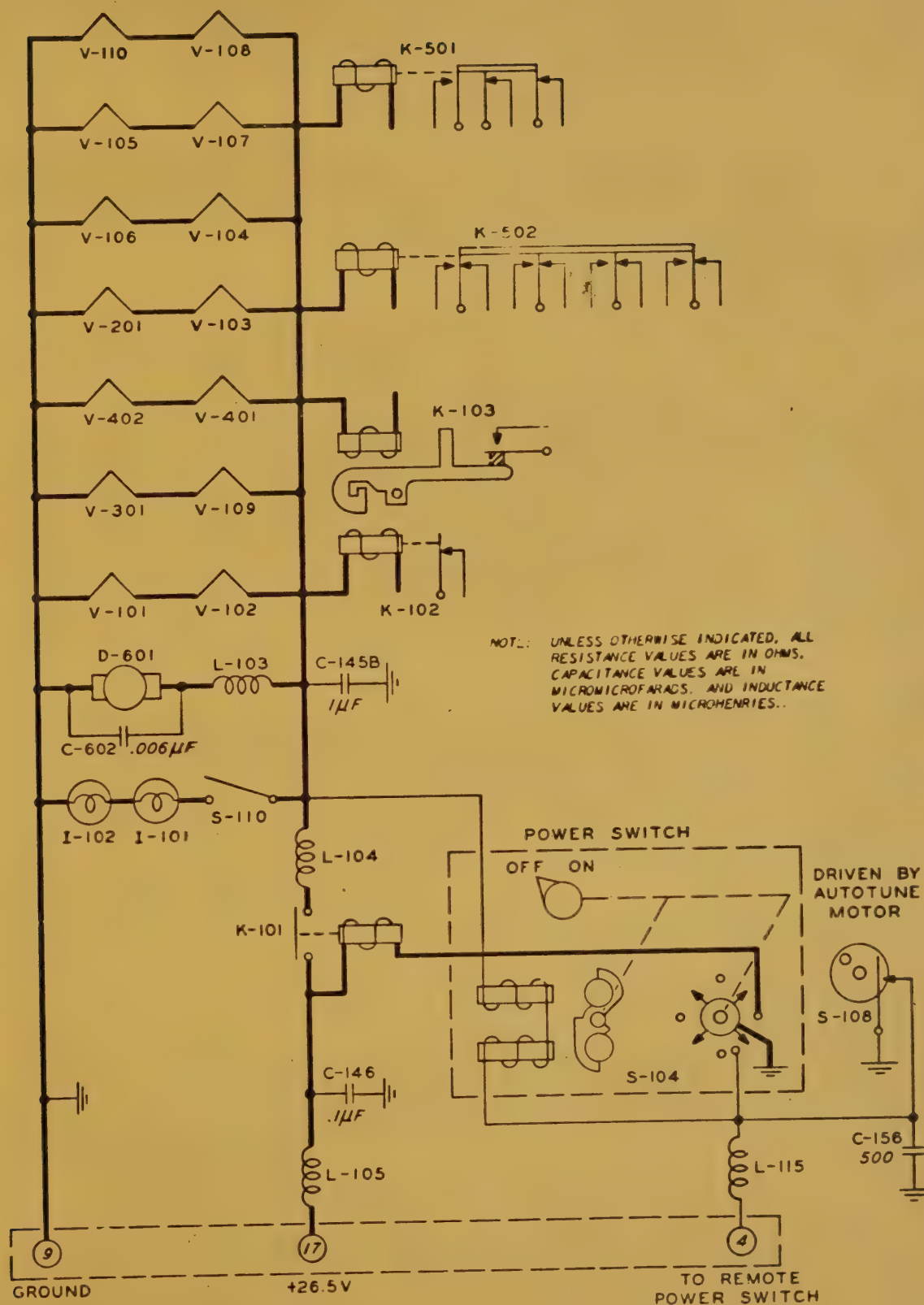


Figure 2-5 Primary Power Circuits





## THEORY OF OPERATION

### Reference Symbols

### Functions

RECEIVE-When the relay is in the receive position, plate voltage is removed from the CFI unit, ant connected to r-f input, CFI output voltage is grounded.

#### d. RECEIVER CIRCUIT DESCRIPTION.

(1) GENERAL. (See Figure 1-2.) - This receiving equipment covers a frequency range of 1.5 mc to 18.5 mc. The superheterodyne circuit employs one stage of tuned r-f amplification and two stages of i-f amplification. The normal operating frequency of the i-f stages is 500 kc but the i-f frequency may be varied 50 kc to either side of 500 kc, i.e., 450 kc to 550 kc, for calibration purposes. For calibration and excitation purposes three oscillators have been incorporated in this receiver. The frequency of one oscillator (CFI) is determined by a 100 kc quartz crystal. Harmonics of 100 kc are used when calibrating the receiver. During actual reception this oscillator circuit is disabled by removing the plate and screen voltages from the oscillator tube. The other two oscillators are variable frequency. One of the variable frequency oscillators is used in conjunction with a multiplier circuit to excite the mixer tube. This oscillator operates in a frequency range of 2000 kc to 3000 kc and the multiplier circuit is used to obtain the higher frequency excitation voltages. The remaining oscillator is essentially a beat frequency oscillator but is also used during the calibration of the receiver. The output of this oscillator is in the frequency range 450 kc to 550 kc. With the reception of voice modulated or mcw signals, the beat frequency oscillator circuit is disabled by removing the plate and screen voltages from the oscillator tube. Both of the variable frequency oscillators are precision built, mechanically and electrically, and give output which is exceptionally stable even under conditions of extreme humidity and temperature change. All three oscillators employ Type 12SJ7 tubes.

Detection is accomplished through the use of a type 1N34 fixed crystal rectifier unit. The output of the detector is coupled to the audio amplifier stages through a noise limiter consisting of a type 12SL7 dual triode and a type 12H6 dual diode. The audio amplifier consists of two tubes, a type 12SJ7, triode connected, in the driver stage and a type 12A6 beam tube, pentode connected, in the output stage. The delayed avc circuit employs a type 12SL7 dual triode tube.

#### (2) RECEIVER CIRCUIT FUNCTION.

##### (a) RF CIRCUITS. (See Figure 2-6.)



## THEORY OF OPERATION

1. GENERAL. - This receiver employs one stage of tuned r-f amplification. Separate excitation for the mixer is provided by an exciter consisting of the high frequency oscillator and multiplier. The oscillator operates in the frequency range of 2 mc to 3 mc. The frequency multiplier is used in conjunction with the oscillator to obtain excitation voltage of the frequency that is necessary for exciting the mixer at the particular frequency that is being received.

The r-f amplifier input and output circuits, the high frequency oscillator grid circuit and the multiplier plate circuit are tuned by varying the position of slugs within the inductors. All of these slugs are positioned by the TUNING control. The proper tuned circuits for the band of frequencies in which reception is desired are selected by the BAND switch.

The following table lists in order the reference symbols, the circuit locations and the functions of the components in the r-f circuits as encountered when tracing the circuit from the antenna input to the mixer output:

<u>Reference Symbols</u>	<u>Circuit Locations</u>	<u>Functions</u>
K-502	Signal or calibrate input circuit	Calibrate-receive relay
C-170	V-101 grid circuit	Antenna coupler capacitor
Z-101	V-101 grid circuit	r-f amplifier grid tuned circuit
C-101, C-102	Series with Z-101 and gnd	r-f amplifier avc bypass
C-103	V-101 cathode circuit	r-f amplifier cathode bypass
C-105, C-106, C-115	V-101 plate, V-102 control grid	Band pass coupling capacitor
Z-107, Z-108, Z-109	V-101 plate, V-102 control grid	Band pass tuned circuits
C-169	Series with Z-107 and gnd	r-f amplifier plate bypass capacitor
C-183	Series with L-129 and L-130	Mixer-first i-f top coupling capacitor
C-112	Paralleled with L-129	Mixer plate tank capacitor
L-129	V-102 plate circuit	Mixer plate inductor
L-130	V-103 grid circuit	First i-f grid inductor
C-184	Paralleled with L-130	First i-f grid tank capacitor
C-117	V-102 plate circuit	Mixer plate bypass capacitor
C-118	V-103 grid circuit	First i-f avc bypass
L-301	V-301 grid circuit	hf osc grid inductor
C-301, C-302	V-301 grid circuit	hf osc trimmer capacitor





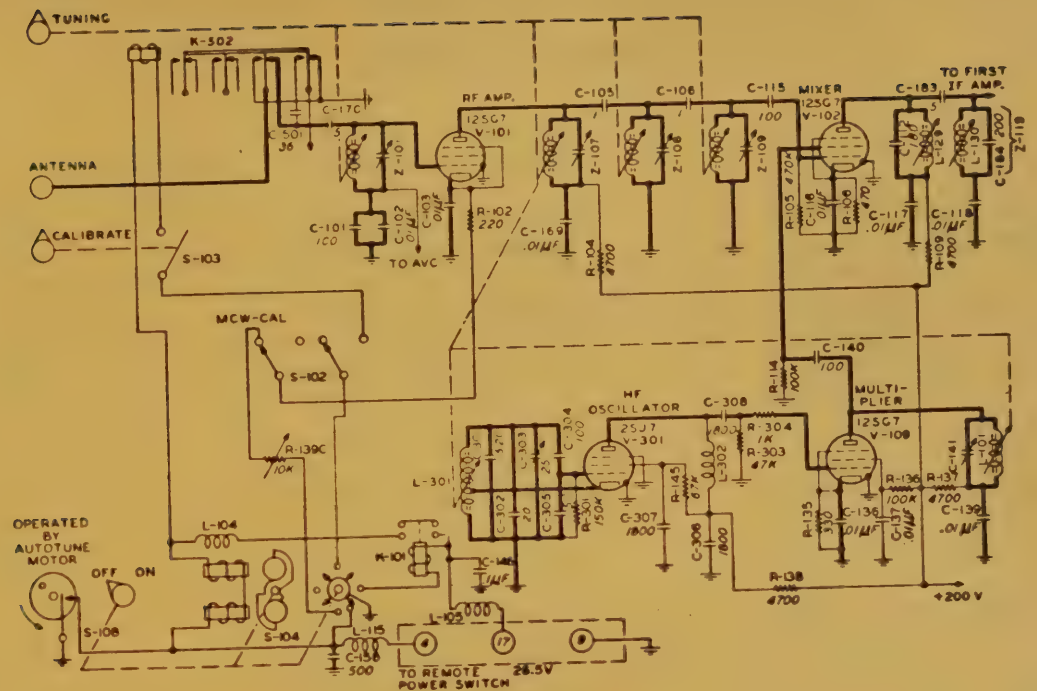
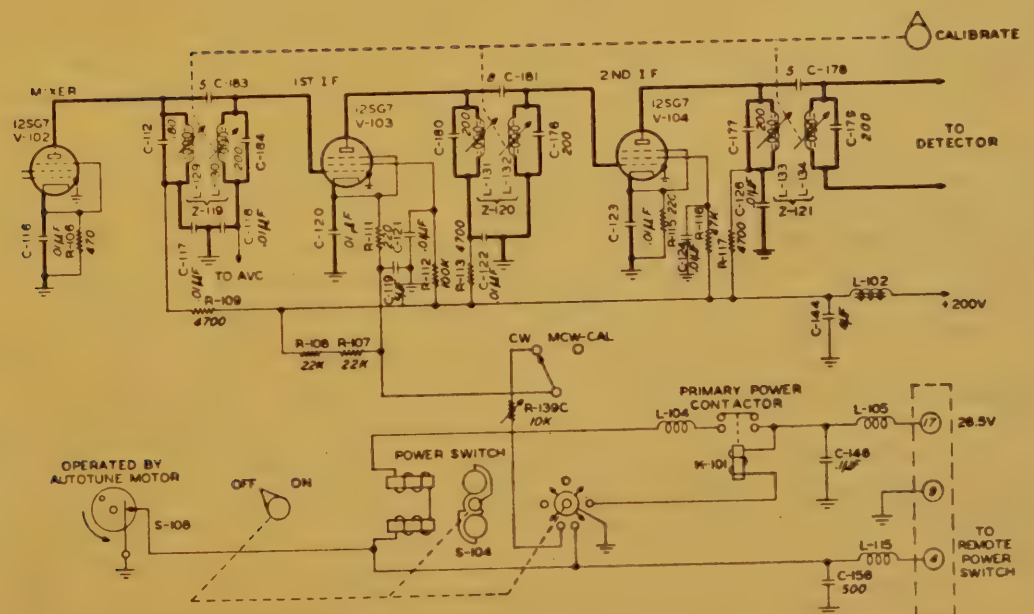


Figure 2-6 RF Circuits



NOTE: UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROCAPACITANCES, AND INDUCTANCE VALUES ARE IN MICROINDUCTANCES.

Figure 2-7 IF Circuits



## THEORY OF OPERATION

<u>Reference Symbols</u>	<u>Circuits Locations</u>	<u>Functions</u>
C-303	V-301 grid circuit	hf osc tuning capacitor
C-304	V-301 grid circuit	hf osc grid coupling capacitor
C-305	V-301 grid circuit	hf osc grid shunt capacitor
C-308	V-301 plate circuit	hf multiplier coupling capacitor
R-304	V-109 grid circuit	hf output equalizing resistor
C-136	V-109 cathode circuit	Multiplier cathode bypass capacitor
C-141	V-109 plate circuit	Multiplier tuning capacitor
L-101	V-109 plate circuit	Multiplier inductor
C-139	Series with L-109 and gnd	Multiplier plate bypass capacitor
C-140	V-109 plate circuit	hf osc mixer coupling capacitor

2. RF AMPLIFIER CIRCUITS. - The input and output circuits of the r-f amplifier tube, V-101, utilize parallel resonant circuits. These circuits are tuned by slugs in the inductors which are positioned by the TUNING control. The tuning capacitors in the parallel resonant circuits are adjusted so that these circuits track with the other tuned circuits in the receiver. A different set of coils and condensers is provided for each of the six receiver bands and are switched into the amplifier circuits by the BAND switch.

3. EXCITER CIRCUITS. - The exciter consists of the high frequency oscillator and the multiplier. The high frequency oscillator employs a Type 12SJ7 tube, V-301, in a variable frequency oscillator circuit operating within the frequency range of 2 mc to 3 mc. The frequency is varied by a tuning slug in the grid inductor, L-301, which is positioned by the TUNING control. The frequency of the high frequency oscillator is always the same for a given setting of the TUNING control regardless of the BAND switch setting.

The plate circuit of the high frequency oscillator is coupled to the control grid of the Type 12SG7 tube, V-109, which is employed by the multiplier. The plate circuit of the multiplier employs a parallel resonant circuit consisting of the inductor, L-101, with a trimmer capacitor in parallel. This circuit is tuned by a slug in the inductor which is controlled by the TUNING control.





## THEORY OF OPERATION

Three different trimmer capacitors are used with the inductor, L-101. (See Figure 7-41). The particular capacitor needed for the frequency range required to properly excite the mixer is selected by the BAND switch. The multiplier plate circuit is tuned to the fundamental and to the second and third harmonics of the frequency of the control grid voltage by condensers, C-141, C-142 and C-143, respectively. Both the fundamental and the second harmonic of the plate voltage are used to excite the mixer. When the fundamental of the multiplier plate voltage is used, one of the resistors R-145, R-146 or R-147 is connected in the circuit to reduce the output from the multiplier so that radiation from the receiver will be reduced.

The following table shows the capacitor in the multiplier plate circuit and the corresponding frequency ranges for the six positions of the BAND switch:

<u>Band</u>	<u>Capacitor In Circuit</u>	<u>Fundamental Frequency Range MC</u>	<u>Harmonic Used to Excite Mixer Frequency</u>	<u>Range of Excitation Voltage MC</u>
A	C-141	2 to 3	Fundamental	2 to 3
B	C-141	2 to 3	Fundamental	2 to 3
C	C-142	4 to 6	Fundamental	4 to 6
D	C-143	6 to 9	Fundamental	6 to 9
E	C-142	4 to 6	Second	8 to 12
F	C-143	6 to 9	Second	12 to 18

**4. MIXER CIRCUITS.** - The mixer stage combines the incoming signal voltage which has been amplified by the r-f amplifier with the excitation voltage from the frequency multiplier. The mixer employs a Type 12SG7 tube, V-102, with the signal voltage from the r-f amplifier impressed on the number one grid and the excitation voltage from the multiplier impressed on the number two grid.

When the receiver is tuned to signals within its frequency range of 1.5 mc to 18.5 mc the frequency of the excitation voltage from the multiplier always differs from the received signal by 500 kc. The heterodyne thus produced appears in the mixer plate circuit which is tuned to a frequency of 500 kc and is the frequency of the voltage amplified by the i-f amplifiers following the mixer.

The following table shows the frequency ranges of the mixer voltages corresponding to the six positions of the BAND switch:



## THEORY OF OPERATION

<u>Band</u>	<u>Frequency Range of Incoming Signal MC</u>	<u>Frequency Range of Excitation Voltage MC</u>	<u>Difference Be- tween Incoming Signal and Exci- tation Voltage MC</u>
A	1.5 to 2.5	2 to 3	+0.5
B	2.5 to 3.5	2 to 3	-0.5
C	3.5 to 5.5	4 to 6	+0.5
D	5.5 to 8.5	6 to 9	+0.5
E	8.5 to 12.5	8 to 12	-0.5
F	12.5 to 18.5	12 to 18	-0.5

(b) I-F AMPLIFIER CIRCUIT. (See Figure 2-7) - Two tuned stages of i-f amplification, employing 12SG7 pentodes, give the receiver the selectivity that is necessary for satisfactory communication. The intermediate frequency, for normal reception, is 500 kc, but during calibration the frequency is varied as much as 50 kc either side of the 500 kc frequency by operating the CALIBRATE control.

The following table lists in order, the reference symbols, the circuit locations and the functions of the components in the i-f amplifier circuits as encountered when tracing the circuit from the mixer output to the detector input:

<u>Reference Symbols</u>	<u>Circuit Locations</u>	<u>Functions</u>
C-116	V-102 cathode circuit	Mixer cathode bypass capacitor
C-112	V-102 plate circuit	Mixer plate tank capacitor
L-129	V-102 plate circuit	Mixer plate inductor
C-178, C-181, C-183	Z-119, Z-120, Z-121	i-f coupling capacitors
L-130	V-103 grid circuit	First i-f grid inductor
C-184	V-103 grid circuit	First i-f grid tank capacitor
C-116, C-122, C-126	V-102, V-103 and V-104 plate circuits	Plate bypass capacitors
C-118	V-103 grid circuit	avc bypass capacitor
C-120	V-103 cathode circuit	First i-f cathode bypass
C-180	V-103 plate circuit	First i-f plate tank capacitor
L-131	V-103 plate circuit	First i-f plate inductor





## THEORY OF OPERATION

<u>Reference Symbols</u>	<u>Circuit Locations</u>	<u>Functions</u>
L-132	V-104 grid circuit	Second i-f grid inductor
C-176	V-104 grid circuit	Second i-f grid capacitor
C-123	V-104 cathode circuit	Second i-f cathode bypass capacitor
C-177	V-104 plate circuit	Second i-f plate tank capacitor
L-133	V-104 plate circuit	Second i-f plate inductor
L-134	V-105A plate circuit	Detector input inductor
C-179	V-105A plate circuit	Detector input tank capacitor

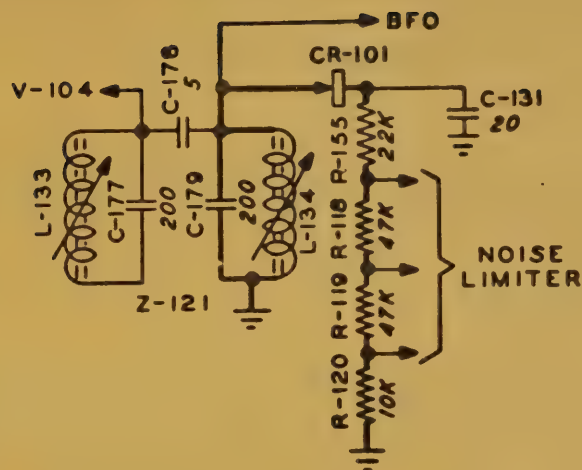
The plate tank circuit of the mixer tube, V-102, and the grid circuit of the first i-f amplifier tube, V-103, are coupled by capacitor C-183 and are tuned by the first i-f transformer Z-119. The plate tank circuit of the first i-f amplifier tube V-103, and the grid circuit of the second i-f tube V-104 are coupled by capacitor C-178 and are tuned by transformer, Z-121. Voltage for operation of the automatic volume control is coupled from the plate of the second i-f stage through capacitor C-127. The cathodes, screens, grid returns and plate returns of the i-f amplifier tubes are bypassed to ground by suitable capacitors.

(c) DETECTOR CIRCUIT. - Refer to Figure 2-8. Rectification of the i-f signal is accomplished by a fixed crystal detector. The crystal detector is excited by i-f voltage taken from the secondary of the last i-f transformer, Z-121. The output of the detector is coupled through the noise limiter circuit to the grid of the audio driver tube.

The following table lists in order the reference symbols, the circuit locations, and the functions of the components in the detector circuit as encountered when tracing the circuit from the detector input to the audio output.

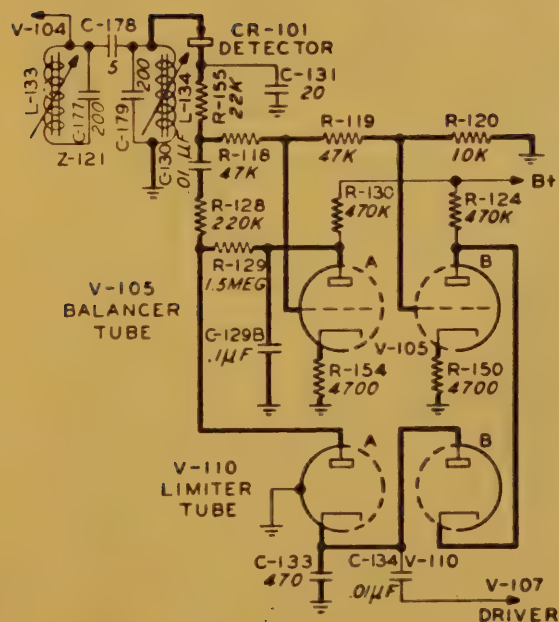
<u>Reference Symbols</u>	<u>Circuit Locations</u>	<u>Functions</u>
L-134	In series with crystal	Input inductor
CR-101	Output of L-134	Rectifier
C-131	Between CR-101 and R-155	r-f filter
R-155	Between CR-101 and R-118	Detector load
R-118	Between R-155 and R-119	Detector load
R-119	Between R-118 and R-120	Voltage divider
R-120	Between R-119 and ground	Voltage divider





NOTE: UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROMICROFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 2-8 Detector Circuits



NOTE: UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROMICROFARADS, AND INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 2-9 Noise Limiter Circuit





## THEORY OF OPERATION

The crystal detector receives excitation from the secondary of i-f transformer Z-121 which is tuned to the i-f frequency by capacitor C-179. Load resistors R-155 and R-118, and voltage divider resistors R-119 and R-120 form the load for the detector. Audio output from the detector is taken from various points along the detector load. The audio reaches audio driver tube V-107 through the noise limiter circuits. (Refer to Figure 2-9)

(d) NOISE LIMITER. - The noise limiter employed in this equipment uses two tubes, a dual triode and a dual diode. This limiter will eliminate or greatly attenuate sharp noise impulses such as ignition noise, radar, etc., from the receiver output. Located between the detector and the first audio stage, the limiter acts like a gate, cutting off the audio for the instant of the noise impulse and immediately restoring it at the end of the noise impulse duration.

The following table lists in order, the reference symbols, the circuit locations, and the functions of the components in the noise limiter circuits as encountered when tracing the circuit from the detector output to the noise limiter output.

<u>Reference Symbols</u>	<u>Circuit Locations</u>	<u>Functions</u>
C-131	Between crystal and R-155	R-F filter
R-155	Between crystal and R-118	Detector load
R-118	Between R-155 and R-119	Detector load
R-119	Between R-118 and R-120	Voltage divider
R-120	Between R-119 and ground	Voltage divider
C-130	Between R-118 and R-128	Impulse coupling capacitor
R-128	Between C-130 and R-129	Impulse coupling resistor
R-129	Between plate of section A of V-105 and plate section A of V-110	Limiter time constant resistor
R-130	Plate of section A of V-105	Balancer tube plate resistor
R-124	Plate of section B of V-105	Balancer tube plate resistor
R-154	Cathode of section A of V-105	Balancer tube cathode resistor
R-150	Cathode of section B of V-105	Balancer tube cathode resistor
C-129B	Plate of section A of V-105	Plate filter
C-133	Cathode of section A of V-110	Noise limiter time constant capacitor
C-134	Cathode of section A of V-110	Audio coupling capacitor



## THEORY OF OPERATION

The dual triode, a type 12SL7 tube, is employed in a balancer circuit which amplifies and furnishes an automatic threshold level in order that the limiter will operate equally effective on all percentages of modulation.

The dual diode, a type 12H6 tube, is the noise limiter tube in which the interruption of the audio signal takes place.

In operation, both grids of the dual triode tube receive bias variations at the rate of the audio frequency by virtue of being connected to the crystal detector load resistor. The plate current of section B of V-105 varies at the audio rate and is coupled to the cathode of section B of the limiter tube, V-110. The plate current of section A of V-105 varies at an average rate due to filter components C-129B, R-129 and C-133. The plate loading resistors R-130 and R-124 are chosen so that with no audio excitation from the detector, the positive voltage on the plate of section A of V-110 is slightly higher than the positive voltage on the cathode of section B of V-110 resulting in a current flow through the limiter tube. Since the plate of section B of V-105 is coupled to the cathode section B of V-110 an audio signal is obtained from the output of the limiter tube, V-110. If a noise impulse with a steep wave front is received, the grid of section B of V-105 will be driven more negative which will cause a rise in plate voltage in section B of V-105. The cathode of section B of the limiter tube V-110, being connected to the plate of section B of V-105, therefore, is driven more positive than the plate of section A of V-110 and the current flow through the limiter tube is interrupted causing a hole to be punched in the signal. While the grid of section A of V-105 receives the same impulse as the grid of section B, the plate of section A does not follow the noise impulse due to the time constant of the filter components C-129B, R-129 and C-133, therefore the plate of section A of limiter tube V-110 does not receive the noise impulse in phase with the cathode of section B of V-110, however the noise impulse is coupled to the plate of section A through resistor R-128 and capacitor C-130 and arrives out of phase, which tends to lower the positive plate potential thus aiding in reversing the polarity between the plate of section A and the cathode of section B of limiter tube V-110, since the plate potential of section A of V-105 varies at an average rate directly proportional to the strength of the incoming signal, the noise limiter threshold is automatically set and the limiter is effective on all values of modulation. The output of limiter tube V-110 is coupled to the grid of the driver tube, V-107, by capacitor C-134.

(e) CALIBRATION CIRCUIT. - The calibrator that is incorporated in this receiving equipment utilizes a crystal controlled oscillator, a variable frequency oscillator and a variable frequency i-f channel. Using the









## THEORY OF OPERATION

above circuits, the receiver may be accurately tuned to any frequency in the range 1500 kc to 18,500 kc without having to follow the usual procedure of tuning for a transmitted signal or depending upon tuning dial calibration.

The following table lists in order, the reference symbols, the circuit locations and the functions of the components in the calibration circuit as encountered when tracing the circuit from the output of the CFI unit to the beat frequency calibration oscillator. Refer to Figure 2-10.

<u>Reference Symbol</u>	<u>Circuit Location</u>	<u>Function</u>
C-407	V-201 plate	Coupling capacitor
C-501	Between K-502 and S-101A	Calibration input capacitor
C-170, C-171, C-172	V-101 grid circuit	Antenna coupling capacitors
C-173, C-174, C-175	V-101 grid circuit	r-f amp grid inductors
Z-101, Z-102, Z-103, Z-104, Z-105, Z-106	V-101, V-103	avc bypass capacitors
C-101, C-102, C-118	V-101, V-103 and V-104 cathodes	Cathode bypass capacitors
C-103, C-120, C-123	V-101 plate, V-102 grid circuits	r-f amplifier band pass inductors
Z-107, Z-108, Z-109, Z-110, Z-111, Z-112, Z-113, Z-114, Z-115, Z-116, Z-117, Z-118	V-101 plate, V-102 grid circuits	Band pass capacitors
C-105, C-106, C-107, C-108, C-109, C-111, C-113, C-114	V-102 grid circuit	Mixer grid coupling
C-115	V-102 plate circuit	Mixer plate inductor
L-129	V-103 grid circuit	First i-f grid inductor
L-130	V-102 plate circuit	Mixer plate tanks
C-112	Z-119, Z-120 and Z-121	i-f coupling capacitors
C-178, C-181, C-183	V-103 grid	First i-f grid tank capacitor
C-184	Between V-109 plate and grid 2 of V-102	Exciter coupling capacitor
C-140	V-102, V-103, V-104 plate circuits	Plate bypass capacitors
C-117, C-122, C-126	V-103 grid circuit	First i-f plate inductor
L-131	V-104 grid circuit	Second i-f grid inductor
L-132	V-104 grid circuit	Second i-f grid tank capacitor
C-176		





## THEORY OF OPERATION

<u>Reference Symbol</u>	<u>Circuit Location</u>	<u>Function</u>
C-180	V-103 plate circuit	First i-f plate tank capacitor
L-133	V-104 plate circuit	Second i-f plate inductor
L-134	V-105A plate circuit	Detector input inductor
C-177	V-104 grid circuit	Second i-f plate tank capacitor
C-179	V-105A plate circuit	Detector input tank capacitor
C-128	V-105A plate circuit	1-f osc coupling
C-203	V-201 plate circuit	1-f osc output coupling

The block diagram, Figure 2-11, shows, in simplified form, the operation of the receiver calibration system. This system of receiver calibration depends primarily upon the frequency stability of the CFI oscillator and the frequency stability of the two variable frequency oscillators. The frequency of the CFI oscillator is controlled by a 100 kc quartz crystal. The variable frequency oscillators are precision built and are exceptionally stable. The low frequency oscillator has been carefully calibrated and it is reasonable to expect that the calibration dial will always indicate the proper number of kilocycles of deviation from the 500 kc intermediate frequency. The frequency of the low frequency oscillator is varied by operating the CALIBRATE control. This control operates a mechanism which changes the positions of the tuning slug within the 1-f osc grid inductor and the tuning slugs within the i-f transformers.

During the process of receiver calibration the frequency of the output of the 1-f osc is set and the frequency of the high frequency osc is varied. It is most important that this procedure be followed when calibrating the receiver. Reversing the operation by setting the TUNING control and varying the CALIBRATE control will result in a "trial and error" method of calibration and consequently a considerable loss of time. If, after once calibrating the receiver for a particular frequency, it is desired to change the calibration even slightly, the low frequency osc frequency should be set and the exciter tuned until zero beat is again obtained.

In order to determine the correct setting of the TUNING control for any particular frequency, a condition must be reached where the frequency of the output of the mixer stage is the same frequency as the output of the low frequency osc. When calibrating the receiver a signal that is generated by the CFI oscillator is used to replace the usual transmitted signal. To obtain output from the mixer that is in the frequency range 450 kc to 550 kc,



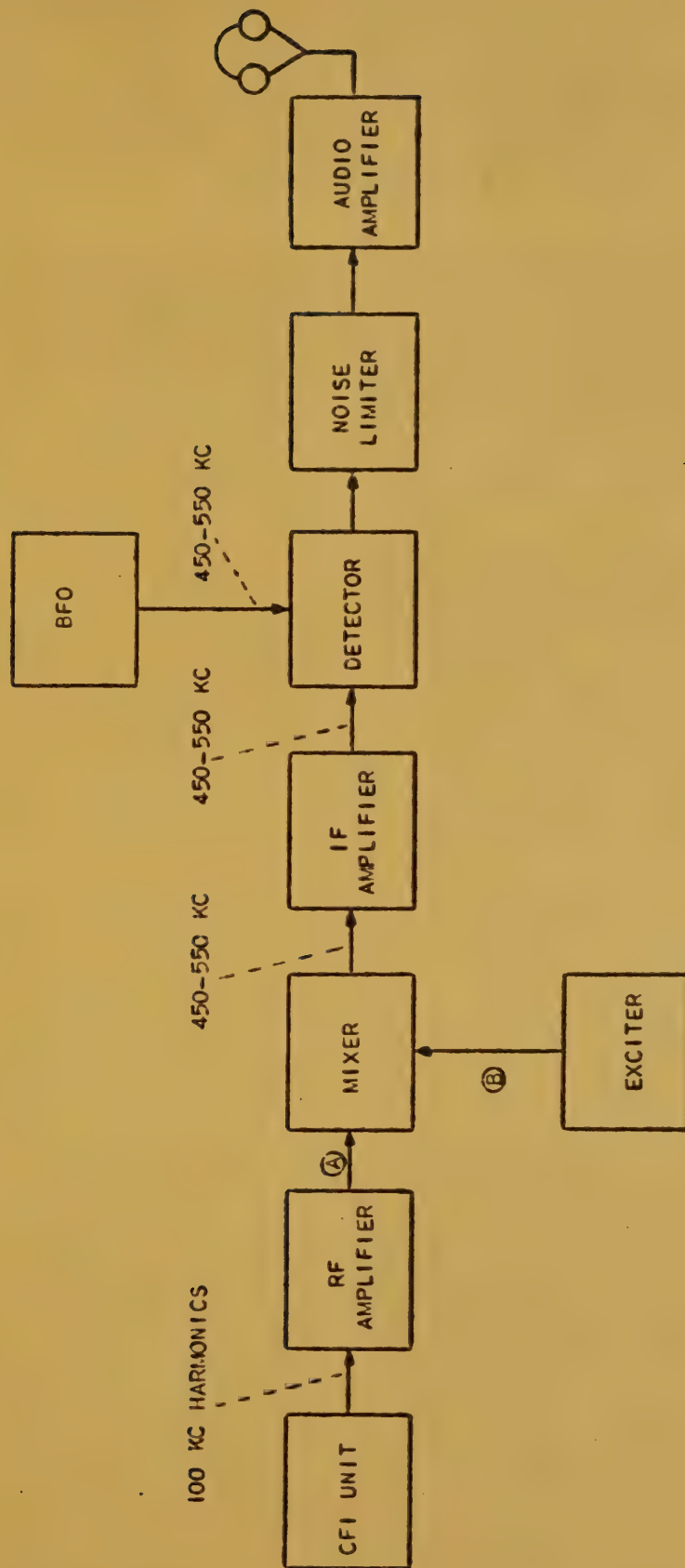


Figure 2-11. Calibration System





## THEORY OF OPERATION

the output of the CFI oscillator is beat against the output of the exciter. As indicated in the table below, the frequency of the output of the exciter is sometimes 500 kc higher and sometimes 500 kc lower than the frequency of the signal that is being received. In Bands A, C, and D the frequency of the output of the exciter is 500 kc higher than the frequency of the signal that is being fed into the mixer by the r-f amplifier. In Bands B, E, and F, the frequency of the output of the exciter is 500 kc lower than the frequency of the signal that is being impressed upon the signal grid of the mixer.

<u>Band</u>	<u>Frequency Range</u>	<u>HF Osc Frequency</u>	<u>Injection Voltage Frequency</u>	<u>Received Freq. Compared to Injection Freq.</u>
A	1.5 mc to 2.5 mc	2 mc to 3 mc	2 mc to 3 mc	-0.5 mc
B	2.5 mc to 3.5 mc	2 mc to 3 mc	2 mc to 3 mc	+0.5 mc
C	3.5 mc to 5.5 mc	2 mc to 3 mc	4 mc to 6 mc	-0.5 mc
D	5.5 mc to 8.5 mc	2 mc to 3 mc	6 mc to 9 mc	-0.5 mc
E	8.5 mc to 12.5 mc	2 mc to 3 mc	8 mc to 12 mc	+0.5 mc
F	12.5 mc to 18.5 mc	2 mc to 3 mc	12 mc to 18 mc	+0.5 mc

When calibrating the receiver, the output of the CFI oscillator is fed into the receiver input circuit and the antenna terminal is grounded by the operation of K-502. All harmonics of the 100 kc oscillator are fed into the receiver but tunable band pass filter circuits in the r-f amplifier and mixer stages attenuate all signals except the harmonic that is to be used for calibration. Although attenuated, the 100 kc harmonic that is to be used will be of sufficient strength to drive the signal grid of the mixer even when the band pass filter and tank circuits are detuned as much as 50 kc. The high frequency osc tank and multiplier tank circuits are tuned by the same control that tunes the r-f amplifier and mixer tank circuits. Thus when the r-f amplifier and mixer circuits are detuned from the 100 kc point, the frequency of the output of the exciter is also varied. A 100 kc harmonic of the CFI oscillator is used for calibration 50 kc above the 50 kc below the point. For example, the 4600 kc harmonic of the 100 kc crystal is used when calibrating the receiver to points in the frequency range 4550 kc to 4650 kc. The 4500 kc and the 4600 kc harmonics will be of equal strength at 4550 kc and the 4600 kc and the 4700 kc harmonics will be of equal strength at 4650 kc. When the r-f amplifier, mixer and exciter circuits are tuned farther than 50 kc away from a 100 kc point, the 100 kc harmonic that is nearest to the frequency to which the r-f, mixer and exciter circuits are tuned becomes the usable signal.



## THEORY OF OPERATION

Referring to the block diagram, Figure 2-11, the frequency of the usable signal at point A is always an even 100 kc harmonic of the output 100 kc CFI oscillator. The frequency of the signal at point B will vary as the TUNING control is rotated but will always be between 450 kc and 550 kc higher or lower in frequency than the frequency of the signal at point A. When receiving signals in Bands A, C or D, the frequency of the signal at point A will be lower than the frequency of the signal at point B. When receiving in Bands B, E or F the frequency of the signal at point A will be higher than the frequency of the signal at point B. With the if transformers tuned to the same frequency as the output of the low frequency oscillator, the output of the mixer will be permitted to reach the detector tube when the frequency of the output of the mixer is near the frequency of the output of the low frequency oscillator. Zero beat between these two signals indicates that the output of the mixer is of exactly the same frequency as the frequency of the output of the lf osc. The receiver is properly calibrated when zero beat between the two signals is obtained.

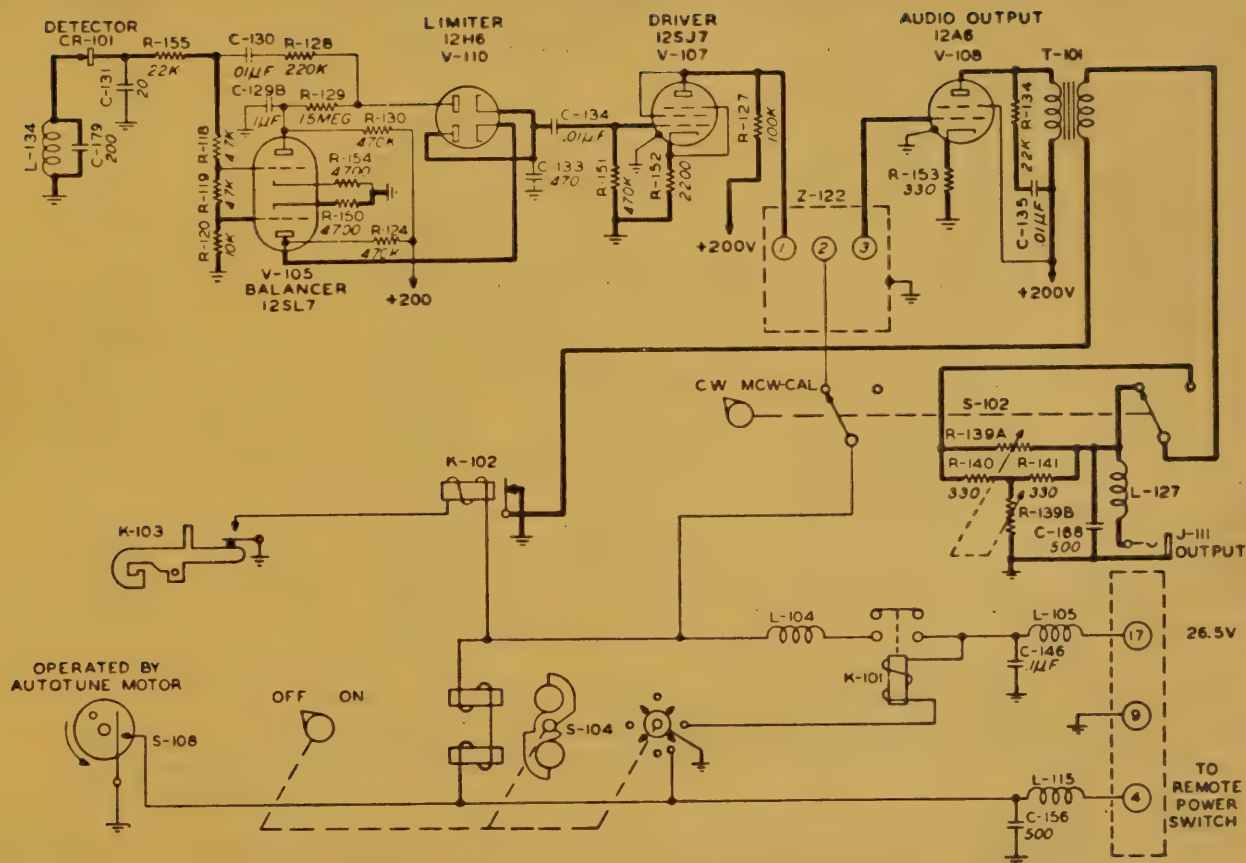
(f) AUDIO AMPLIFIER CIRCUITS. - Audio amplification is obtained by one audio driver and one power amplifier stage. The audio voltage that is developed across the diode detector load resistors, R-155, R-118, R-119 and R-120, is impressed across the noise limiter circuit. The current flowing in the limiter tube develops voltage across resistor, R-151. This voltage is applied to the grid of the audio driver V-107 through capacitor C-134. The output of the audio driver V-107 is connected to the input of the audio filter Z-122. The filtered audio voltage is impressed on the grid of the 12A6 power amplifier tube V-108. An output transformer couples the output of the power amplifier to the head phone jack, J-111, through the mcw-cw switch, S-102. A "T" pad attenuator is inserted in series with output when S-102 is in the MCW position. The audio output is also terminated at pin No. 11 of connector P-101. Operating this switch to CW position takes the "T" pad out of the circuit and disables the avc. Relay contacts on the audio disabling relay K-102 open the secondary circuit of the audio transformer, T-101, when the Autotune system is functioning.

The following table lists in order; the reference symbols, the circuit locations and functions of the components in the audio amplifier circuits as encountered when tracing the circuit from the noise limiter output to the audio output connector jacks:

<u>Reference Symbol</u>	<u>Circuit Location</u>	<u>Function</u>
C-134	V-107 grid circuit	First audio coupling capacitor
R-151	V-107 grid circuit	Audio driver grid resistor
R-131	Terminal 3 of J-105	l-f osc decoupling resistor
R-127	V-107 plate circuit	Audio driver plate load resistor







NOTE: UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROCAPACITANCE, AND INDUCTANCE VALUES ARE IN MICROHENRIES

Figure 2-12 Audio Amplifier Circuit



## THEORY OF OPERATION

<u>Reference Symbol</u>	<u>Circuit Location</u>	<u>Function</u>
Z-122	V-107 plate, V-108 grid	Audio filter
S-102	One section connects Z-122 in circuit	cw-mcw-cal switch
R-153	V-108 cathode	Audio output cathode resistor
R-134, C-135	Connected in series across T-101 primary	Audio equalization network
T-101	V-108 plate circuit	Audio output transformers
R-139A	Connects to R-140 and R-141	"T" pad bridging resistor
R-139B	Connects junction of R-140, R-141 to ground	"T" pad resistor
R-140	Series with R-141 and T-101 secondary	"T" pad resistor
R-141	Series with R-140 and J-111	"T" pad resistor
C-168	Shunted across J-111	Phone jack filter capacitor
L-127	Series with J-111	Audio output r-f filter
J-111	Connected to L-127 and ground	Audio output jack
K-102	Connects one side of T-101 secondary to ground	Receiver disabling relay

(3) AUTOMATIC VOLUME CONTROL. - Delayed avc is employed in this receiver. An accelerated characteristic which enables the avc circuit to reach maximum efficiency on strong signals is a feature of the circuit. Refer to Figure 2-13.

The following table lists, in order, the reference symbols, the circuit locations, and the functions of the components in the i-f amplifier circuits as encountered when tracing the circuit from the avc input to the grids of the controlled tubes.

<u>Reference Symbols</u>	<u>Circuit Locations</u>	<u>Functions</u>
C-132	Plate of section A of V-106	Accelerator r-f coupler
C-127	Plate of section B of V-106	AVC r-f coupler
R-123	Plate of section A of V-106	Accelerator plate load
R-126	Cathode of section A of V-106	Accelerator plate load
R-122	Cathode of section A of V-106	Voltage divider resistor





## THEORY OF OPERATION

<u>Reference Symbols</u>	<u>Circuit Locations</u>	<u>Functions</u>
R-133	Between R-122 and ground	Voltage divider resistor
C-129A	Cathode of section B of V-106	Filter capacitor
R-121	Plate of section B of V-106	AVC load
R-125	Plate of section B of V-106	Filter and time constant resistor
C-129C	Between R-125 and ground	Filter and time constant capacitor
R-111	Grid return of V-103	AVC decoupling
C-118	Grid return of V-103	AVC decoupling
R-102	Grid return of V-101	AVC decoupling
C-101, C-102	Grid return of V-101	AVC decoupling

The delay feature of the avc functions in such a fashion that the controlled tubes do not receive any avc voltage while a weak signal is being received, thereby allowing the receiver to operate in the most sensitive condition. This delay feature is obtained by placing a positive voltage on the avc tube cathode which biases the plate with a negative potential and prevents rectification. However, as soon as the received signal is great enough in amplitude, the signal voltage overcomes the fixed bias and the avc tube begins to function. In order to receive all avc voltage possible from the avc tube, section A of V-106 is connected in a rectifier circuit which rectifies part of the i-f signal and applies a d-c bucking voltage to the delay bias on section B of V-106. In this manner, a strong signal will reduce the delay bias on the avc tube and allow more avc voltage to be generated, thus an accelerated avc characteristic is obtained.

Radio frequency voltage for operation of the avc system is obtained from the primary of i-f transformer Z-121 through capacitor C-127. Resistor R-121 forms the avc load. The grid of the avc tube section B of V-106, is grounded and the cathode is connected to the positive side of the plate supply through resistors R-126 and R-132.

Section A of V-106 is connected in a diode rectifier circuit which furnishes the bucking voltage that cancels out the delay bias on section B of V-106.

Resistor R-125 and capacitor C-129 form a filter to remove all r-f and audio from the avc voltage. Suitable resistors and capacitors are connected in the avc supply line at the grid returns of the controlled tubes for decoupling purposes.



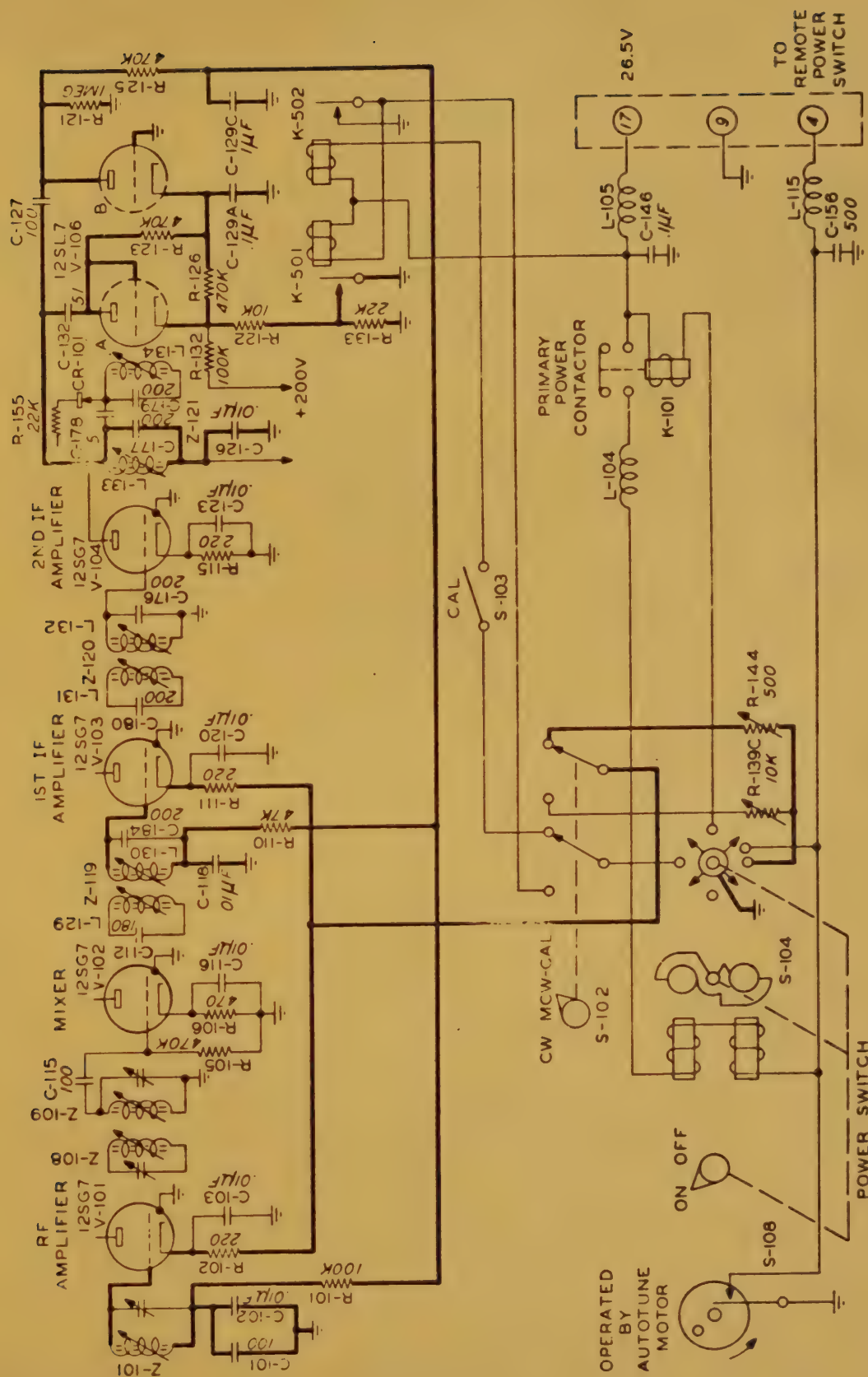


Figure 2-13 Automatic Volume Control Circuit





## THEORY OF OPERATION

The avc circuit is connected to a set of contacts on the cw-mcw relay, K-501. The operation of relay K-501 applies a higher positive potential (delay bias) to the avc circuit and causes the avc to become partially inoperative when cw is selected.



## SECTION III

### INSTALLATION AND ADJUSTMENT

#### 1. INSTALLATION.

##### a. PRELIMINARY.

(1) UNPACKING. - All the equipment for the Model 51H-3 Receiving installation which is supplied by the contractor is in one crate. This equipment consists of a receiver unit, a receiver mounting base, and a power connector to be attached to the mounting base. If the crate is marked with arrows to indicate the upright position, remove the crate cover only. Remove the packing material and lift the units out carefully. Search all the packing material for small packages. Inspect each unit for loose screws and bolts. Be certain that all controls such as switches, dials, etc., work properly. All claims for damage should be filed promptly with the transportation company. If a claim for damage is to be filed, the original packing case and packing material must be preserved. Check the equipment received against the table EQUIPMENT SUPPLIED (Section 1, paragraph 2, page 1-1).

(2) CHECKING VACUUM TUBES AND PLUG-IN UNITS. - Loosen the receiver unit from the cabinet by disengaging the Dzus fastener that protrudes through the rear of the cabinet. Remove the receiver unit from the cabinet by pulling it forward. With the unit removed from the cabinet check all of the vacuum tubes to be certain that the proper tubes are securely inserted in the sockets. (Refer to figure 3-1 for the location of the tubes.) Make sure that all the plug-in units are firmly fastened.

(3) CHECKING CONTROLS FOR PROPER OPERATION. - Unlock the AUTOTUNE mechanism that operates the BAND switch and TUNING control by rotating each locking key two revolutions in a counterclockwise direction. Check each control by rotating it through the entire range.

#### CAUTION

Do not force the controls to rotate. If the controls do not operate satisfactorily with minimum pressure, check for bent parts, etc.

Check the BAND switch by turning it to each of the six positions. Rotate the TUNING control through the entire range. Rotate the BFO-CALIBRATE control. Turn the CW-MCW-CAL switch to the CW position and to the MCW-CAL position. Turn the ON-OFF switch to the ON position and release it to the OFF position by pressing the knob toward the panel. Operate the VOLUME control. Rotate the CHANNEL selector switch to each of the ten channels.

After checking the tubes, plug-in units and controls, replace the receiver in the cabinet, push it all the way in and engage the Dzus fastener.





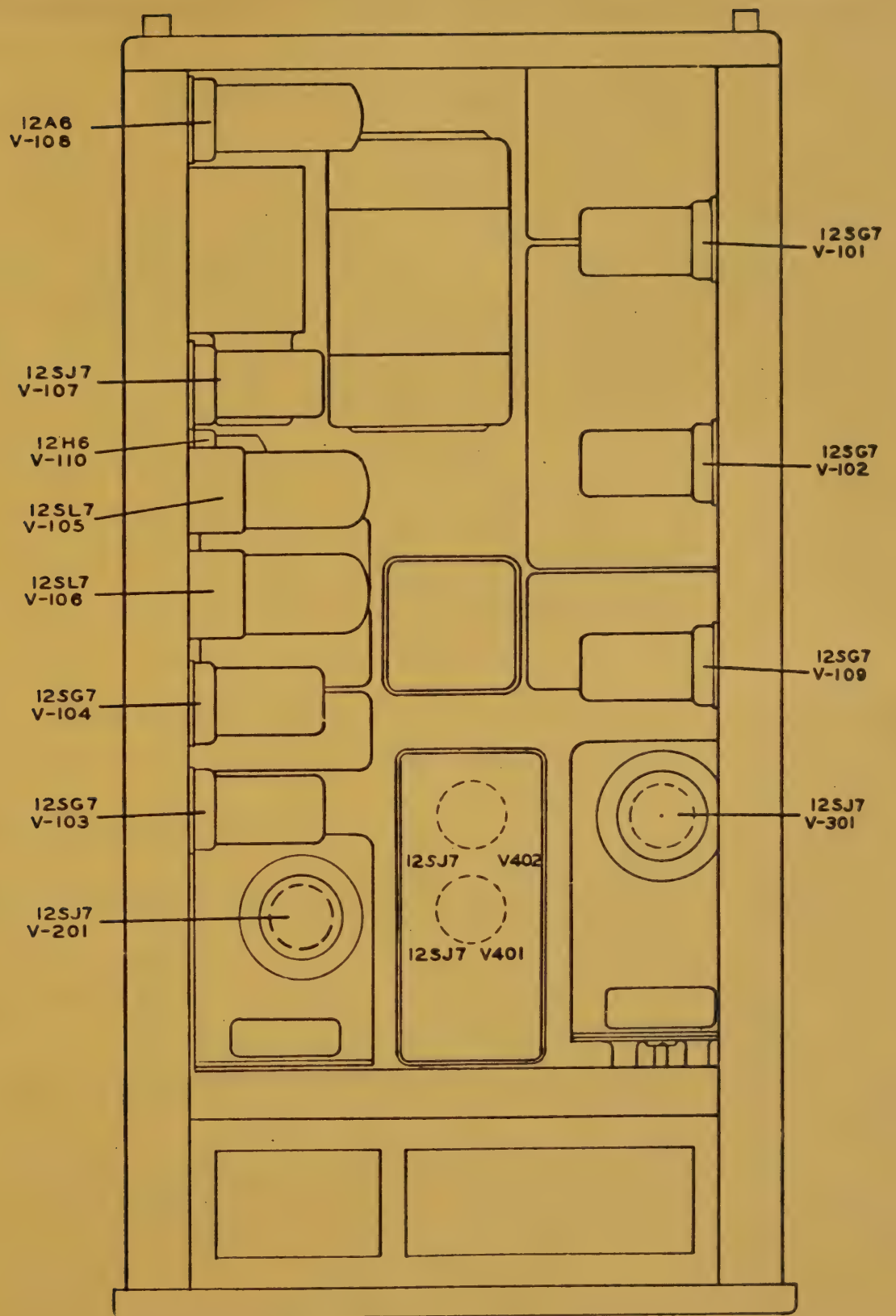


Figure 3-1 Tube Placement Diagram



## INSTALLATION AND ADJUSTMENT

### (4) BENCH TEST.

(a) POWER SOURCE. - This equipment has been designed to operate from a 26.5 volt d-c power source. The filaments of the tubes are connected in a series-parallel circuit across the power input and the dynamotor, AUTOTUNE motor and relays operate directly from the 26.5 volt supply. The equipment will operate with voltages 10% above or 10% below 26.5 volts but for the best results the input voltage should be maintained as close to 26.5 volts as possible. High voltages may damage the vacuum tubes. Low voltages may result in insufficient emission from the vacuum tube cathodes. With low voltage the time required to change channels will be longer.

### (b) INSTRUMENTS, TOOLS AND EQUIPMENT REQUIRED.

1. 26.5 volt d-c supply.
2. Mounting base with plug receptacle attached.
3. Wire for connecting power source to plug receptacle.
4. A set of headphones (approx 300 ohm).
5. A 500 ohm variable resistor.
6. A single-pole, single-throw switch.
7. A dummy antenna consisting of 10 ohm of non-inductive resistance and a 100 mmf capacitor in series.
8. Audio output meter. (A Weston 687, a milliwattmeter or a 15 volt meter shunted by enough resistance to match the 300 ohm output of the receiver.)
9. Signal generator.

(c) TEST BENCH SETUP. - If a number of installations are being made at one base it is desirable to make up a test bench so that each equipment may be checked before being mounted in the aircraft. Considerable time and labor may be saved if all units are checked and operating properly before being installed. (Refer to figure 3-2 for a suggested test bench setup.)

Use number 14 gauge wire for the power leads. Use number 18 gauge wire for the leads from the terminals numbered 4 and 10. Use number 22 wire for all the control leads.









## INSTALLATION AND ADJUSTMENT

(d) TEST PROCEDURE. - The following test procedure will reveal any damage that will affect the operation of the equipment.

1. Connect the power source to the proper terminals on the receptacle at the rear of the mounting base.
2. Connect the signal generator output to the ANTENNA terminal on the receiver through the dummy antenna. (Signal modulated 30% at 1000 cps.)
3. Connect the output meter to the receiver output circuit. (Either through the PHONES jack or by connecting to terminals on the rear of the unit.) If the voltmeter is used with 300 ohm shunt, calculate the power by using the following formula:

$$\text{Power (milliwatts)} = \frac{\text{voltage}^2}{0.3}$$

4. Turn the signal generator on and set the frequency of the generator at 2.0 mc.
5. Rotate the ON-OFF switch to the ON position.
6. Rotate the VOLUME control clockwise as far as it will go.
7. Rotate the SENS control clockwise as far as it will go.
8. Rotate the BAND switch to A.
2. Turn the CW-MCW-CAL to MCW-CAL.
10. Adjust the TUNING control for maximum output. Check receiver operation by checking the sensitivity and selectivity at 2, 2.5, 3.5, 5.5, 8.5, 12.5, 15.0 and 18.1 mc. Refer to Paragraphs (e) 1. and (e) 2. below. Check by setting the signal generator to the above frequencies, tuning for maximum output and observing the input necessary to give a chosen output.

### (e) MINIMUM ACCEPTABLE PERFORMANCE.

1. SENSITIVITY. - The conditions of measurement are: VOLUME control fully advanced, signal modulated 30 percent at 1000 cps, PHONE reception with a r-f input to the equipment not in excess of five microvolts and using a dummy antenna consisting of a 10 ohm non-inductive resistor and a 100 mmf capacitor in series. An audio output of 100 milliwatts shall be obtained at any frequency with an input of 5 microvolts.





## INSTALLATION AND ADJUSTMENT

2. SELECTIVITY. - The overall selectivity of the receiver at any frequency shall be approximately as set forth below. (Conditions the same as stated above in Paragraph (2), 1.)

<u>Attenuation DB Below Resonance</u>	<u>Kilocycles Off Resonance</u>
6	3
20	6.5
40	11.75
60	17

The method of checking the selectivity is as follows:

a. Connect the signal generator through the recommended dummy antenna (100 mmf capacitor in series with 10 ohms) to the antenna terminal of the receiver.

b. Connect a 300 ohm loading device (with a db meter incorporated) to the output terminals of the receiver.

c. Turn the equipment ON and, with the BFO turned on, tune the receiver to zero beat with the output of the signal generator.

d. Apply 30% modulation to the signal generator and turn the BFO OFF. Adjust the signal generator output to just below the point where the receiver AVC starts to operate.

e. Tune the signal generator either side of the test frequency until the output on the db meter reads the desired amount of attenuation as indicated in the table above.

f. Read the kilocycles-off-resonance as indicated by the signal generator dial and check with the Kilocycles Off Resonance column in the table above.

g. Repeat the above procedure on all the test frequencies.

When the equipment has been carefully checked and all units are found to be operating satisfactorily, the equipment may be installed in the aircraft. If the performance does not come up to the minimum acceptable performance standards outlined above, refer to Paragraph 2. of this Section and attempt to adjust the controls so that the standards of performance can be met. If it is impossible to obtain the required performance by adjusting the controls, turn the unit over to the maintenance personnel for servicing.









## INSTALLATION AND ADJUSTMENT

### b. RECEIVER INSTALLATION PROCEDURE.

(1) SELECTING MOUNTING POSITION FOR UNIT. - A clearance of at least one-half inch must be allowed on the sides and at the top for the free movement of the unit on the shock mount. A minimum clearance of 18 inches in front of the receiver should be allowed to permit adjusting the controls. If the controls are not to be adjusted after the receiver is installed in the aircraft, a minimum clearance of four inches must be provided in front of the unit for installing and removing the unit from the mounting base. A clearance of at least 4 inches behind the receiver is necessary for the removal of the connector plug from the shock mount if the cable comes through the rear of the plug. A clearance of 3 inches behind the receiver is sufficient if the cable does not come through the rear of the plug. Of course, there must be enough space either in front of or above the receiver to permit the placing of the unit on the mounting base.

(2) PLACING AND SECURING THE MOUNTING BASE. - Use eight #10 screws for securing the mounting base to the aircraft. If a good connection to the structural parts of the aircraft is not obtained through the mounting base, a bonding strap may be connected from the mounting base to the aircraft or the ground connection may be made to the ground post on the front of the receiver. The ground connection should be as short as possible.

### (3) POWER AND CONTROL CONNECTIONS.

(a) GENERAL. - One or more control boxes or console control units may be used with this equipment. Nineteen terminals of the mounting base connector J-901 are used in making connections. Terminals numbered 1, 2, 12, 18 and 19 are not used. It is recommended that wire strippers, long nose pliers, side cutting pliers, screwdriver, soldering iron and rosin core solder be available for making the connections.

(b) POWER INPUT CONNECTIONS. - Two number 14 gauge insulated wires long enough to reach from the receiver mounting base connector to the 26.5 volt d-c power source are required for the power connections. The positive connection is soldered to terminal number 17. The negative connection is soldered to terminal number 9. Do not expose any more of the bare wire than is necessary for the soldered connection.

(c) CONTROL LINE CONNECTIONS. - Use number 18 gauge wire for the connections to terminals number 4 and 10 in the receiver mounting base connector. Use number 22 gauge wire for the control leads from the other terminals. Solder the wires into the connector terminals being careful not to strip the insulation from the wire any farther back than necessary for the soldered connection.



## INSTALLATION AND ADJUSTMENT

### (4) PLACING AND SECURING THE UNIT ON THE MOUNTING BASE.

(a) PLACEMENT OF UNIT. - The mounting base has been designed to permit the removal of one receiver and the installation of another in the least possible time. After the mounting base has been installed and all connections to the mounting base connector have been made, the receiver may be fastened to the mounting base. Before placing the unit on the mounting base, be certain that the unit is securely fastened in the cabinet. Place the receiver on the mounting base and carefully push the unit toward the mounting base connector. Be certain that there is proper alignment between the connector on the receiver and the mounting base connector before exerting pressure on the front of the unit.

(b) SECURING UNIT. - When the receiver has been pushed back as far as it will go, lift the lock assemblies over the angles that protrude from the receiver front panel and tighten the wing nuts. Insert a piece of safety wire through one of the holes in the wing nut and through the hole in the screw between the wing nut and the round nut on the end. Twist the free ends of the wire together.

### (5) ANTENNA SYSTEM CONNECTIONS.

(a) ANTENNA. - The receiver is designed for fixed aircraft antennas ranging from 17 to 40 feet in length. The lead-in from the antenna to the receiver should be as short and direct as possible. A minimum of two inches slack should be allowed to permit free movement of the receiver on the shock mounts. A binding post has been provided on the front panel of the receiver for the end of the lead-in.

(b) GROUND. - If a good connection to the structural part of the aircraft is not obtained through the mounting base, the ground connection may be made through a bonding strap between the mounting base and the aircraft or the ground connection may be made to the binding post on the front of the receiver. Make the ground lead as short as possible.

c. ACCESSORIES. - Besides the basic units, consisting of the receiver, mounting base and mounting base connector, the following accessories are necessary to complete a Model 51H-3 Receiving installation: Headset, junction box, jack box and antenna. The headsets, junction box, jack box and antenna are furnished by the customer. Fixed aircraft antennas ranging from 17 to 40 feet in length are suitable. The installation procedure for the accessories will vary considerably with the aircraft in which the equipment is being installed.





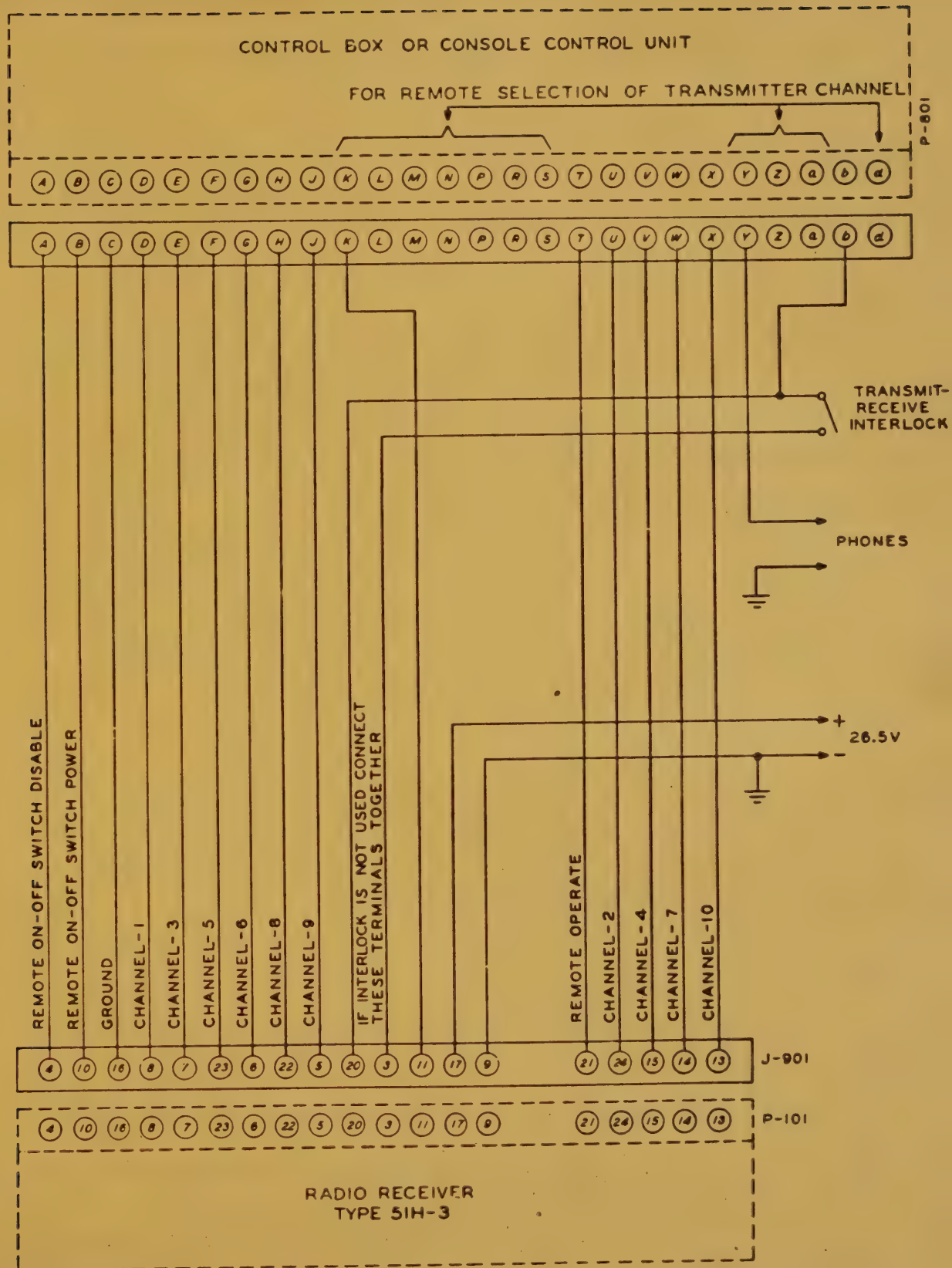
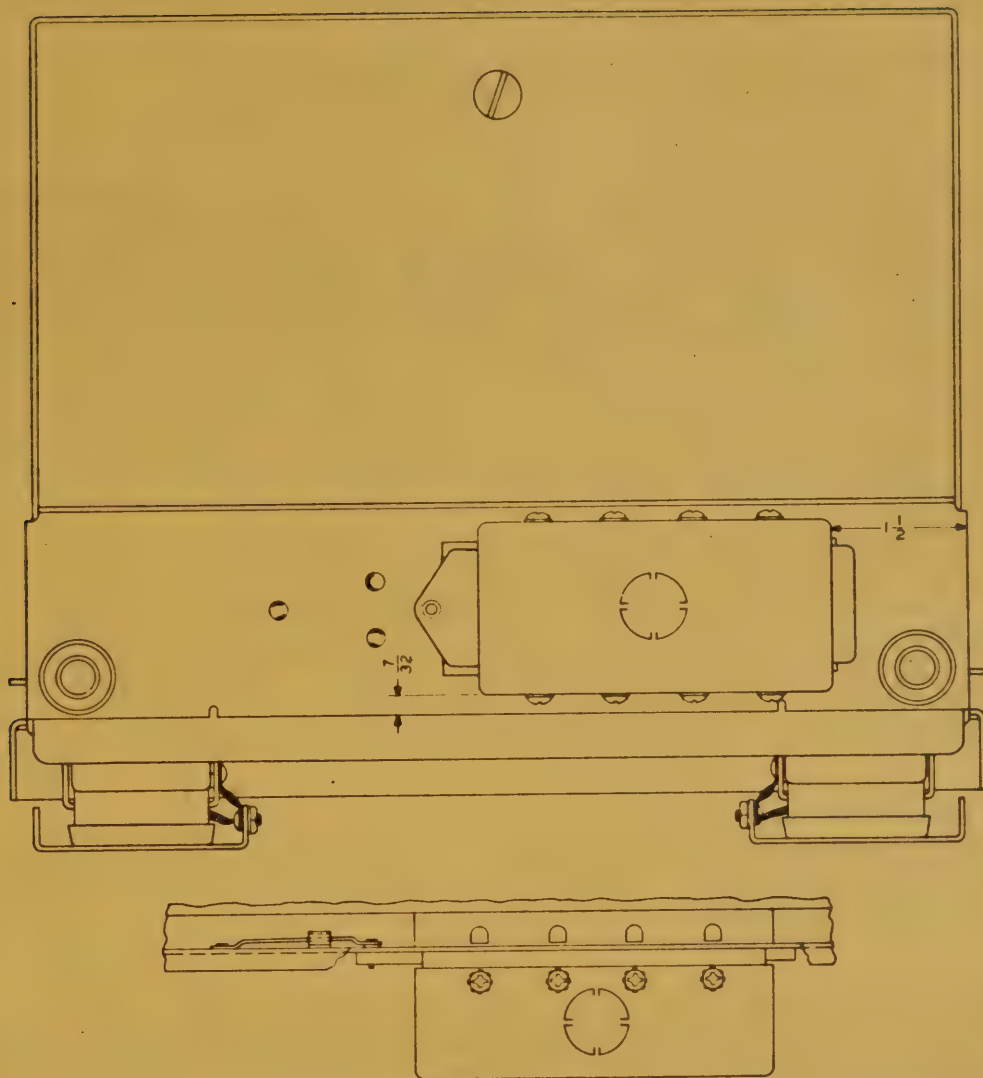
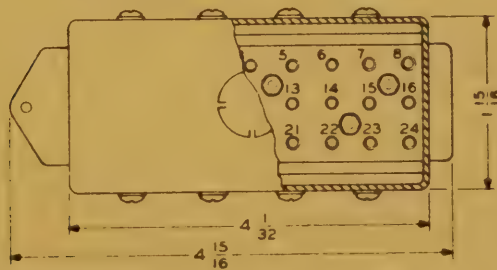


Figure 3-4 External Connections to Receiver Unit

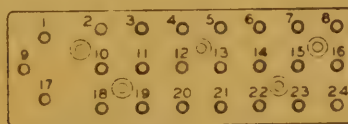




REAR AND TOP VIEWS ILLUSTRATING MOUNTING OF PLUG RECEPTACLE (P-1602) TO MOUNTING BASE



REAR VIEW OF PLUG RECEPTACLE (P-1602) AND TERMINAL BOARD SHOWING POSITIONS OF TERMINALS



TERMINAL BOARD

Figure 3-5 Receiver Plug Connector Details





## INSTALLATION AND ADJUSTMENT

### 2. ADJUSTMENT.

a. GENERAL. - The adjustment of this receiving equipment consists principally of calibration and AUTOTUNE adjustment. When properly synchronized, no adjustment of the AUTOTUNE mechanism, except the unlocking, setting and locking of the BAND switch and TUNING control, is necessary. The AUTOTUNE mechanism is highly dependable and will only require synchronizing if some part of the mechanism has been replaced or removed for repair. The synchronizing of the mechanism is considered a maintenance operation rather than an adjustment operation. Complete instructions for the synchronizing of the AUTOTUNE mechanism are included in the MAINTENANCE SECTION of this book.

#### NOTE

To unlock the AUTOTUNE mechanism that operates the TUNING control and the BAND switch, rotate the locking keys two revolutions in a counter-clockwise direction. Lock the controls by rotating the locking keys in a clockwise direction until the torque necessary to rotate the keys indicates that pressure is being applied to the stack of AUTOTUNE stop rings.

b. FUNCTION OF CONTROLS. - All of the receiver controls are mounted on the front panel. In each case a word or words have been engraved on the panel to indicate the function of the particular control. The following paragraphs give a brief outline of the elements in the receiver that are operated by each control:

(1) POWER ON-OFF SWITCH. - The power ON-OFF switch, located in the lower left-hand corner of the panel, is a combination manually and electrically operated power and circuit control switch. In addition, the cathode circuits for the r-f amplifier, the mixer, and the first i-f amplifier tubes, the energizing circuit for the cw relay, the circuit to the CHANNEL selector switch, and the energizing circuit for the primary power control relay are cleared for remote control by an electrical impulse to the electrically operated release section of the switch. The electrical impulse will be received from the control that desires to control the receiver. All ON-OFF switches should be equipped with an impulsing circuit so that only one station may have control at any given instance.

(2) CHANNEL SELECTOR SWITCH. - The CHANNEL selector switch is used to select any of the 10 available AUTOTUNE channels upon which reception is desired. The numerals that are engraved on the receiver panel correspond to the 10 AUTOTUNE channels. This control operates a single pole switch that is associated with the AUTOTUNE control circuit.



## INSTALLATION AND ADJUSTMENT

(3) **BAND SWITCH.** - The BAND switch is connected to the AUTOTUNE Singleturn Unit and is used to select the band of frequencies that contain the one upon which reception is desired. The frequency range of the receiver, 1500 kc to 18,500 kc, is divided into six bands. The frequency band may be manually selected, if the AUTOTUNE Singleturn Unit stop rings are unlocked, by rotating the locking key in a counterclockwise direction. The BAND switch operates a mechanism which selects the r-f coupling and r-f amplifier plate tank circuits that will tune to the band of frequencies in which reception is desired and selects the proper plate tank circuits for the high-frequency oscillator and frequency multiplier stages.

(4) **BFO-CALIBRATE CONTROL.** - This receiver has been provided with a system of calibration that permits the tuning of the receiver circuit to any exact frequency without having to tune for an incoming signal. The BFO-CALIBRATE control tunes the three i-f transformers and the beat frequency oscillator grid tank circuit by changing the positions of slugs within the inductors. The operation of this control also applies plate and screen voltages to the CFI (crystal-controlled frequency indicator,) oscillator tube, grounds the antenna terminal of the receiver, connects the output of the CFI oscillator to the input circuit of the receiver, disables the avc action, and connects a potentiometer in the cathode circuits of the r-f amplifier, mixer and first i-f amplifier tubes. The control may be rotated to vary the frequency of the oscillator 100 kc, 50 kc above and 50 kc below the i-f frequency (500 kc.)

(5) **TUNING CONTROL.** - The r-f coupling, r-f amplifier plate tank, high-frequency oscillator grid and plate tank, and frequency multiplier plate tank circuits of this receiver are all tuned by varying the inductance of the circuits. The TUNING control, which is associated with the AUTOTUNE Multiturn Unit, operates a mechanism that controls the inductance in these circuits by determining the positions of slugs within the inductors. The control may be manually operated if the stoprings are unlocked. The control may be unlocked by rotating the locking key in a counterclockwise direction.

(6) **MCW-CAL-CW SWITCH.** - When it is desired to receive either mcw or voice modulated signals this switch should be operated to the MCW-CAL position. When the switch is in the MCW position the avc circuit is operative and a variable "T" pad is connected between the output of the audio amplifier and the PHONES jack. When the switch is operated to the CW position the avc circuit is partially disabled, the output of the audio amplifier is coupled directly to the phones jack, and the volume is controlled by a cathode potentiometer as explained above.

(7) **VOLUME CONTROL.** - This control operates two sections of variable resistors, a bridge "T" pad and a potentiometer. The "T" pad is connected between the output of the audio amplifier and the PHONES jack whenever mcw





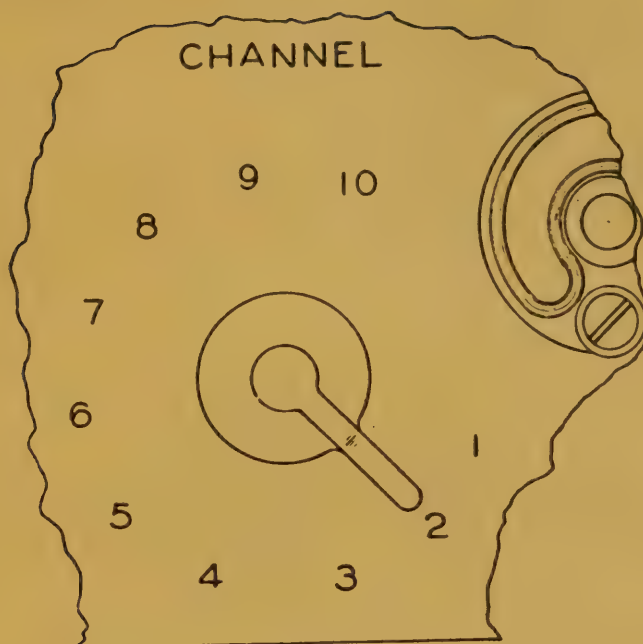


Figure 3-6 Channel Selector Details

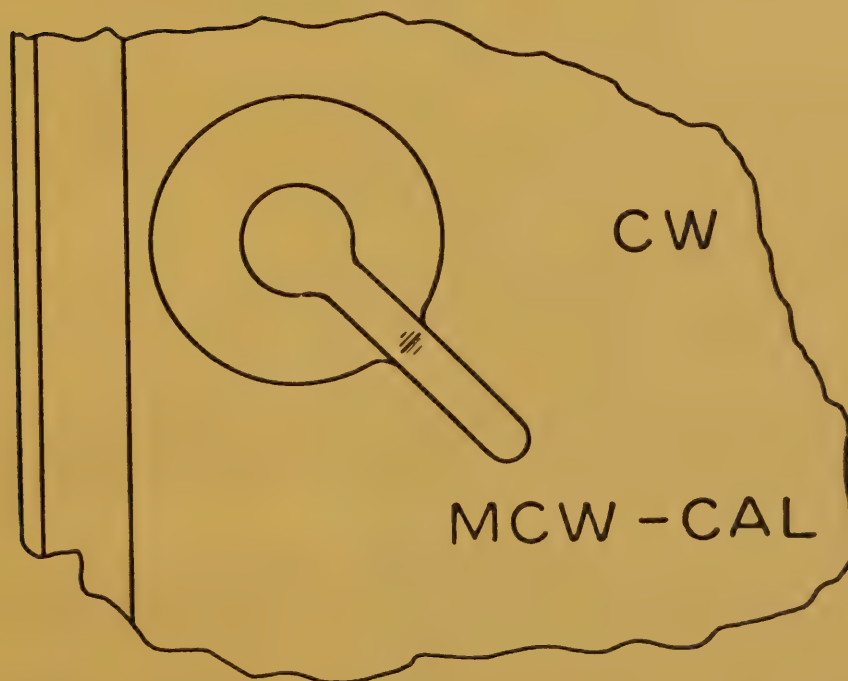


Figure 3-7 CW-MCW-CAL Selector Details



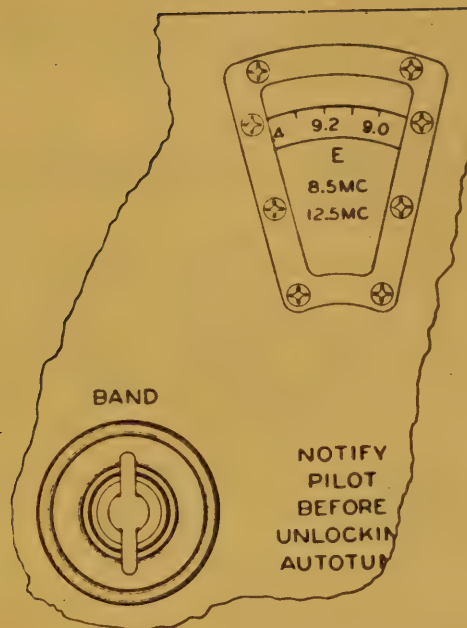


Figure 3-8 Band Switch Details



Figure 3-9 Calibrate and BFO Control





## INSTALLATION AND ADJUSTMENT

reception is selected. When cw reception is selected, a potentiometer is connected in the cathode circuits of the r-f amplifier and first i-f amplifier tubes. When mcw reception is selected the potentiometer is shorted out.

(8) SENS CONTROL. - The threshold sensitivity is controlled by the screw-driver adjustment marked SENS. This control is connected in series with the cathodes of the r-f, mixer and i-f stages in the receiver for the purpose of adjusting the sensitivity of the receiver to operate most satisfactorily under conditions of electrical interference. A dust cover is placed over the panel opening behind which this control is located.

c. PRINCIPLE OF OPERATION. - This receiver employs a superheterodyne circuit with one stage of r-f amplification and two stages of i-f amplification. The i-f transformers are variable and will tune to frequencies in the range 450 kc and 550 kc. The variable characteristic of these transformers is used only during the calibrating of the receiver. When the receiver has been calibrated and it is desired to receive a transmitted signal, the i-f transformers are adjusted so that the i-f frequency is exactly 500 kc. Therefore the actual i-f frequency, as used for reception is 500 kc. For calibration, and excitation purposes three oscillators have been incorporated into this receiver. The frequency of one oscillator circuit is determined by a 100 kc quartz crystal. Harmonics of this 100 kc signal are used when calibrating the receiver. During actual reception this oscillator circuit is disabled by removing the plate and screen voltage from the oscillator tube.

The frequency converting stage of this receiver is separately excited. One of the variable frequency oscillators is used to excite the mixer tube. This oscillator operates in the frequency range 2000 kc to 3000 kc and a frequency multiplier circuit is used to obtain the higher frequency excitation voltages. The remaining oscillator tube is essentially a beat frequency oscillator, but is also used during the calibration of the receiver. The output of this oscillator is in the frequency range 450 kc to 550 kc.

When voice modulated or mcw signals are being received, the beat frequency oscillator circuit is disabled by removing the plate and screen voltages from the oscillator tube.

Two stages of audio amplification provide ample output for the operation of headphones at the receiver panel and for the operation of headphones at the remote control positions. One triode connected pentode tube is used for the first audio stage. The audio output stage is a type 12A6 pentode.

The noise silencer, following a fixed crystal detector, employs two tubes. A dual triode type tube is connected in an accelerated avc circuit.



## INSTALLATION AND ADJUSTMENT

The avc circuit is operative when voice modulated or mcw signals are being received. The circuit is partially disabled if cw reception is selected and during the time that the receiver is being calibrated.

(1) GENERAL ADJUSTMENTS TO PREPARE THE EQUIPMENT FOR OPERATION. - Before proceeding with the adjustments, choose the 10 frequencies upon which the receiver is to be operated. A brief outline of the control adjustments necessary for the preparation of this receiver for routine operation is given below:

- (a) Operate the Power Switch to the ON position.
- (b) Operate the CHANNEL Selector switch to Position 1.
- (c) When the AUTOTUNE cycle has been completed, unlock the stop rings on the AUTOTUNE Singleturn and Multiturn Units by rotating the locking keys two revolutions in a counterclockwise direction.
- (d) Rotate the BAND Switch to the correct position for the frequency that has been selected for Channel 1.
- (e) Rotate the TUNING Control until the dial indicates the frequency upon which reception is desired.
- (f) Rotate the CALIBRATE Control a number of dial divisions corresponding to the last two digits and fractions thereof of the desired frequency.
- (g) While listening to the output of the receiver, rotate the TUNING Control about the desired frequency until zero beat is obtained.
- (h) Lock the BAND and TUNING Controls by rotating the locking keys clockwise until the AUTOTUNE stop rings are tight.
- (i) Return the CALIBRATE Control to exact "0" setting.
- (j) Select the type of reception desired with the CW-MCW switch.
- (k) Repeat steps (c) thru (i) for the remaining nine frequencies.

### NOTE

If it is desired to receive voice-modulated signals, operate the CW-MCW-CAL switch to the MCW position.





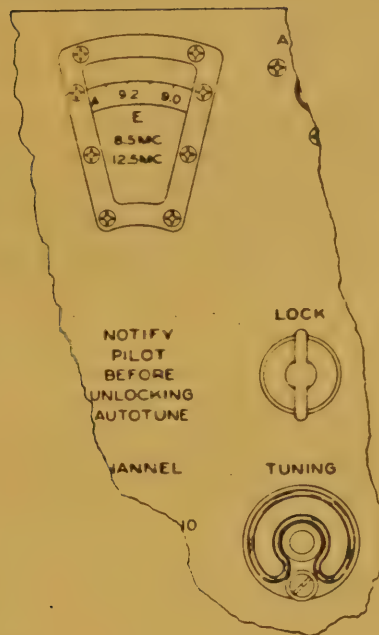


Figure 3-10 Frequency Indicator and Main Details

500 2247

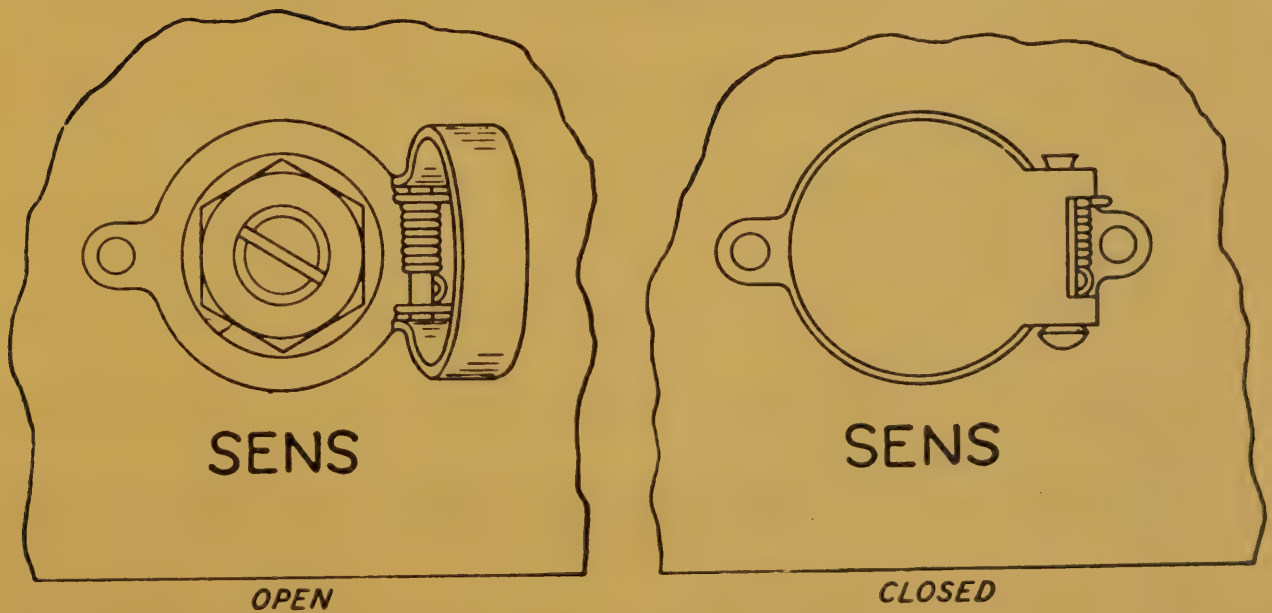


Figure 3-11 Sensitivity Adjustment Details

500 2247



## INSTALLATION AND ADJUSTMENT

### d. CALIBRATION.

(1) CALIBRATION THEORY. - The Calibrator that is incorporated in this receiving equipment utilizes a crystal controlled oscillator, a variable frequency oscillator and a variable frequency i-f channel. Using the above circuits, the receiver may be accurately tuned to any frequency in the range 1500 kc to 18,500 kc without having to follow the usual procedure of tuning for a transmitted signal or depending upon tuning dial calibration.

The system depends primarily upon the frequency stability of the CFI unit (crystal controlled frequency indicator) and the frequency stability of the two variable frequency oscillators. The frequency of the CFI oscillator is controlled by a 100 kc quartz crystal. The variable frequency oscillators are precision built and are exceptionally stable. The beat frequency oscillator has been carefully calibrated and should always indicate the proper number of kilocycles of deviation from the 500 kc i-f frequency. The frequency of the beat frequency oscillator is varied by operating the BFC-CALIBRATE control. This control operates a mechanism which changes the position of the tuning slugs within the lf osc. grid inductor and the tuning slugs within the i-f transformers.

During the process of receiver calibration the frequency of the output of the lf osc. is set and the frequency of the hf (high frequency) oscillator is varied. It is most important that this procedure be followed. The frequency of the hf oscillator is varied as the TUNING control is rotated. In order to determine the correct setting of the tuning control for any particular frequency, a condition must be reached where the frequency of the output of the mixer stage is the same frequency as the output of the lf osc.

In the calibration position the output of the CFI is fed into the receiver input circuit and the antenna terminal is grounded by the operation of K-502. All harmonics of the 100 kc oscillator are fed into the receiver but tunable band pass filter circuits in the r-f amplifier and mixer stages attenuate all signals except the harmonic that is used for calibration. Although attenuated, the 100 kc harmonic that is to be used will be of sufficient strength to drive the signal grid of the mixer even when the band pass filter and tank circuits are detuned as much as 50 kc. The hf oscillator tank and multiplier tank circuits are tuned by the same control that tunes r-f amplifier and mixer tank circuits. A 100 kc harmonic of the CFI oscillator is used for calibration 50 kc above and 50 kc below the point. When the r-f amplifier, mixer and exciter circuits are tuned farther than 50 kc away from a 100 kc point, the 100 kc harmonic that is nearest to the frequency to which the r-f, mixer and exciter circuits are tuned becomes the usable signal. The frequency of the exciter output will vary as the TUNING





## INSTALLATION AND ADJUSTMENT

control is rotated but will always be between 450 kc and 550 kc higher or lower in frequency than the 100 kc harmonic signals. When receiving signals in BAND A, C, or D, the frequency of the input signal is lower than the exciter frequency. When receiving in BAND B, E, or F, the frequency of the input signal is higher than the exciter frequency. With the i-f transformers tuned to the same frequency as the frequency of the output of the beat frequency oscillator, the output of the mixer will be permitted to reach the detector tube when the frequency of the output of the mixer is near the frequency of the output of the low frequency oscillator. Zero beat between these two signals indicates that the output of the mixer is exactly the same frequency as the frequency of the output of the lf osc. The receiver is properly calibrated when zero beat between these two signals is obtained.

(2) CALIBRATION PROCEDURE. - As indicated in the paragraphs above, the first step in the calibration procedure is to set the frequency of the beat frequency oscillator. In brief, the procedure from this point consists of setting the position of the TUNING control so that the output of the mixer is of the same frequency as the output of the lf osc. Under no circumstances should the TUNING control be set and the BFO-CALIBRATE used as the variable when calibrating the receiver.

The calibration procedure and functioning of the circuits during calibration are best explained by using an example. If, for instance, 2125 kc is selected as the frequency to which it is desired to tune the receiver, the procedure outlined below should be followed:

### (A) STEP-BY-STEP PROCEDURE.

1. Operate the Power Switch to the ON position.
  2. Select the AUTOTUNE channel upon which it is desired to calibrate the receiver.
  3. When the AUTOTUNE cycle has been completed unlock the stop rings on the Multiturn and Singleturn Units by rotating the locking keys two revolutions in the counterclockwise direction.
  4. Operate the BAND switch to the position that includes the frequency 2125 kc (Band A).
  5. Rotate the TUNING control until the dial indicates 2.125 mc.
  6. Rotate the BFO-CALIBRATE control until the dial indicates 25.
- Place CW-MCW-CAL switch in CAL position.



## INSTALLATION AND ADJUSTMENT

### NOTE

The BFO-CALIBRATE control should always be set so that the calibration dial indicates the last two digits of the frequency in kilocycles upon which it is desired to calibrate the receiver. If it is desired to calibrate the receiver within a fraction of a kilocycle of a frequency, the BFO-CALIBRATE control should be set so that the calibration dial indicates the last three digits of the frequency including the decimal.

7. With the beat frequency oscillator set as described above and while listening to the output of the receiver, rotate the TUNING control about the 2125 kc point until zero beat between the output of the mixer and the output of the bfo is obtained.

8. Carefully lock the BAND and TUNING controls by rotating the locking keys in a clockwise direction until the AUTOTUNE stop rings are tight.

9. Rotate the BFO-CALIBRATE control back to the "0" setting.

### WARNING

The BFO-CALIBRATE control must be returned to exact zero so that the receiver input circuit will be reconnected to the antenna terminal, the CFI oscillator will be disabled and the i-f channel will be returned to 500 kc. The receiver is now calibrated for 2125 kc on this particular AUTOTUNE channel. The type of reception may be selected by operating the MCW-CAL-CW switch. If it is desired to receive voice modulated signals the switch should be operated to the MCW-CAL position. The AUTOTUNE mechanism will reposition the controls to tune the receiver to 2125 kc whenever this channel is selected.

### e. TUNING ADJUSTMENTS.

### WARNING

This equipment employs voltages (250 volts) which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment with the cabinet removed. Be certain that the ON-OFF switch is in the OFF position and that the dynamotor has stopped rotating before touching any of the components. When making measurements with the equipment operating and the cabinet removed use dry well-insulated prods.





## INSTALLATION AND ADJUSTMENT

(1) ADJUSTMENT PROCEDURE. - If it is desired to change the frequency of one or more of the AUTOTUNE channels follow the procedure outlined below:

(a) With the Power Switch in the ON position, operate the CHANNEL Selector Switch to the number corresponding to the channel that is to be changed.

(b) When the AUTOTUNE cycle has been completed unlock the AUTOTUNE stop rings by rotating the locking key on the BAND Switch Control and the locking key above the TUNING Control two revolutions in a counterclockwise direction.

(c) Operate the BAND Switch to the band that contains the frequency upon which reception is desired.

(d) Rotate the TUNING Control until the main dial indicates the desired frequency.

(e) Rotate the BFO-CALIBRATE Control so that the calibration dial indicates the last two digits of the frequency desired.

(f) While listening to the output of the receiver, rotate the TUNING Control about the original setting and carefully set the control so that zero beat is obtained.

(g) Carefully lock the AUTOTUNE stop rings by rotating the locking keys in a clockwise direction until tight.

(h) Return the BFO-CALIBRATE Control to the "0" setting.

Repeat the above procedure for as many channels as it is desired to reset.

### CAUTION

When locking the AUTOTUNE Controls do not use any instruments. Use only the thumb and forefinger and tighten until the torque necessary to rotate the keys indicates that pressure is being applied to the stack of AUTOTUNE stop rings.

## (2) AUDIO ADJUSTMENTS.

(a) VOLUME. - There are two methods of controlling the level of the audio output of the receiver. For cw reception a rheostat, located in the cathode circuits of the r-f amplifier and first i-f amplifier tubes, is used to vary the bias on the tubes there by controlling the receiver output. For mcw-cal (MCW-CAL position also used for phone) reception a bridge T pad is used and the rheostat is short circuited. The bridge T pad is connected between the



## INSTALLATION AND ADJUSTMENT

output winding of the audio output transformer and the PHONE jack. The rheostat and bridge T pad are connected to the same shaft and are operated by the VOLUME control located on the front panel. The bridge T pad is not connected in the circuit when cw emission is selected. When adjusting the VOLUME control, the main consideration is understandability and comfort. The automatic volume control circuit will maintain the audio output level within close limits on most signals.

(3) THRESHOLD SENSITIVITY ADJUSTMENT. - A rheostat, connected in series with the receiver r-f amplifier tube and first i-f amplifier cathodes, is used to adjust the sensitivity of the receiver. This control, adjusted through a hole in the front panel by a straight lipped screwdriver, is adjusted for best signal to noise ratio for each individual installation. The adjustment should be made with the airplane engine running and the receiver turned ON and completely adjusted but no signal being received. Proceed as follows to complete the adjustment.

(a) Operate the CW-MCW-CAL selector switch to MCW-CAL position.

(b) Rotate the VOLUME control to the full ON position.

(c) Engage the screwdriver slot in the end of the SENS adjustment shaft with a straight lipped screwdriver.

(d) Adjust the SENS control clockwise or counterclockwise until the condition of maximum tolerable noise level from electrical interference is encountered.

(e) If the interference is not great enough to cause discomfort to the operator at any setting of the control, the control should be rotated to the full ON position (extreme clockwise position).

(4) ADJUSTMENT FOR OPERATION. - When making the TUNING adjustments as described above it must be kept in mind that these adjustments must be carried out for each of the ten channels.

### NOTE

Each AUTOTUNE control must be securely locked before changing channels. The control setting will be lost if the control is allowed to rotate without first locking the stop ring with the locking key.

### f. PRE-FLIGHT TEST.

(1) FREQUENCY. - If a frequency standard is available, the receiver can be checked for accuracy of calibration against the standard. However, in





## INSTALLATION AND ADJUSTMENT

many instances a frequency standard will not be available, therefore it will be necessary to become familiar with frequencies of various other broadcasting services such as control tower transmitters, fixed services or broadcasting stations. If such checks are not satisfactory, other transmitters in the immediate vicinity may be used to check the receiver calibration. The equipment should be checked on at least two frequencies on each position of the BAND switch, preferably near the upper and lower frequency limits.

CHANNEL vs FREQUENCY	
CHANNEL	FREQUENCY
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

(2) RECEIVER SENSITIVITY. - If a signal generator and output meter are available, the sensitivity of the receiver should be checked on all positions of the BAND switch. Refer to Paragraph 1. for the test procedure and the instruments required. The sensitivity measurement conditions are the input value of a 400 cps 30% modulated signal which results in a 6 db signal to noise ratio or a 100 mc output, whichever occurs first. Under these conditions sensitivity varies between 1.0 mv and 2.5 mv. Average sensitivity is approximately 2.5 mv. If no sensitivity measuring equipment is available, the receiver may be compared with other identical installations, or signals of known reliability can be tuned in and compared. The sensitivity should be checked in at least two positions of the TUNING dial on



## INSTALLATION AND ADJUSTMENT

each range of the BAND switch, preferably near each end of the TUNING range. In event no signals are available for reception, the equipment can be checked by rotating the CW-MCW-CAL control to the MCW-CAL position and listening to the 100 kc signal from the CFI unit. A good signal should be encountered over the complete tuning range of the receiver at every 100 kc. The results of pre-flight test may be checked against typical readings included below.

BAND	FREQUENCY MC	INPUT UV	OUTPUT MW
A	2.0	2.4	100
B	3.0	2.0	100
C	4.5	2.5	100
D	7.0	2.5	100
E	10.0	2.3	100
F	15.5	2.5	100

g. FLIGHT TEST. - Due to conditions arising when the airplane is in flight, it is suggested that the equipment be checked as soon as the airplane clears the field. Contact with the control tower on phone emission on one channel should show up any defects due to vibration or noise originating from the airplane.





## SECTION IV

### OPERATION

This section contains only the steps that are necessary to control the equipment for routine operation and the actual operations necessary in order to make minor adjustments. All adjustments are outlined in brief form and it is suggested that the operator refer to the ADJUSTMENT section (Section II paragraph 2) of this handbook for a more detailed explanation of the procedure for the adjustment of the receiver circuits and the AUTOTUNE system.

#### 1. STARTING THE EQUIPMENT.

##### a. PROCEDURE.

(1) Rotate the ON-OFF switch on the receiver front panel or the ON-OFF switch on any remote control unit in a clockwise direction until it catches.

#### 2. STOPPING THE EQUIPMENT.

##### a. PROCEDURE.

(1) Push the ON-OFF control all the way in toward the panel.

#### NOTE

The operator of this radio equipment should become familiar with a means of disconnecting the equipment from the power source, such as a main supply switch or circuit breaker, in case an emergency shut down is necessary.

#### 3. GENERAL.

a. FUNCTION OF THE EQUIPMENT. - This receiver is designed to receive voice cw and mcw signal within the frequency range of 1500 kc to 18.5 mc. Ten pre-tuned channels can be selected simply by operating a CHANNEL selector switch. Manual operation is possible by unlocking the tuning controls and allowing the stop rings of the AUTOTUNE heads to slip. One pre-tuned channel setting will be destroyed by this method and will have to be reset before automatic tuning can be again used on this channel.

#### NOTE

The AUTOTUNE controls must be locked before automatic channel selection is attempted. Failure to lock the control will result in the dial settings being lost.



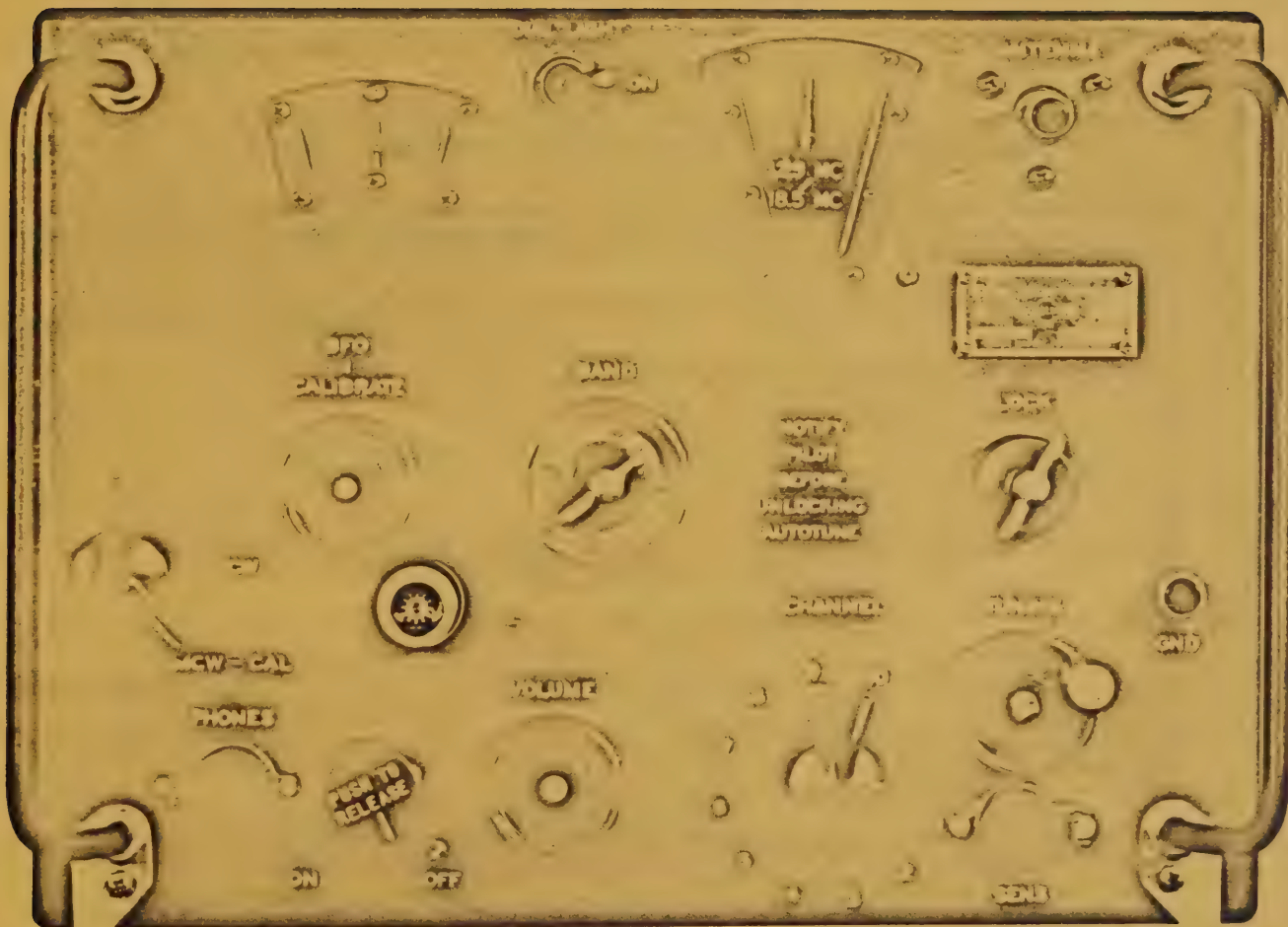


Figure 4-1 Panel Control Functions





## OPERATION

### b. NOTES ON OPERATION.

- (1) Placing the CW-MCW-CAL selector in the CW position allows cw reception.
- (2) Placing the CW-MCW-CAL selector in the MCW-CAL position allows mcw-cal and phone reception.
- (3) After the controls have been locked it is good practice to check the locking keys frequently to make certain that they are tight.
- (4) If the receiver has been turned off, allow at least one minute for the tubes to rise to operating temperature.
- (5) Correct errors in tuning or adjustment of the equipment as soon as possible after discovery.

### 4. ROUTINE OPERATION.

If the receiver circuits have been tuned and the controls locked for all 10 frequency channels, the procedure outlined below should be followed during routine operation.

#### a. PANEL CONTROL. - (See figure 4-1)

- (1) Insert the headphones cord plug into the PHONES jack.
- (2) Rotate the ON-OFF switch to the ON position.
- (3) Select the AUTOTUNE channel corresponding to the frequency upon which reception is desired.
- (4) Rotate the CW-MCW-CAL selector switch to the position corresponding to the type of reception desired.
- (5) Regulate the audio level to the input to the phones with the VOLUME control.
- (6) Press the ON-OFF control to turn the receiver off.

### 5. TUNING ADJUSTMENTS.

If it is desired to change the frequency of one or more of the AUTOTUNE channels follow the procedure outlined below: (See figure 4-2)



## OPERATION

### CAUTION

Do not unlock any AUTOTUNE unit until pilot has been notified not to take control. (When receiver is connected for remote operation.)

- a. With the Power Switch in the ON position, operate the CHANNEL Selector Switch to the number corresponding to the channel that is to be changed.
- b. When the AUTOTUNE cycle has been completed unlock the AUTOTUNE stop rings by rotating the locking key on the BAND Switch Control and the locking key above the TUNING Control two revolutions in a counterclockwise direction.
- c. Operate the BAND Switch to the band that contains the frequency upon which reception is desired.
- d. Rotate the TUNING Control until the main dial indicates the desired frequency.
- e. Rotate the BFO-CALIBRATE Control so that the calibration dial indicates the last two digits of the frequency desired.
- f. While listening to the output of the receiver, rotate the TUNING Control about the original setting and carefully set the control so that exact zero beat is obtained.
- g. Carefully lock the AUTOTUNE stop rings by rotating the locking keys in a clockwise direction until tight.
- h. Return the CALIBRATE Control to the "0" setting.

### NOTE

If cw reception is selected rotate CALIBRATE Control a few dial divisions until peak audio output is obtained.

Repeat the above procedure for as many channels as it is desired to reset.

### NOTE

All channels must be set up to receive the same type of emission when the receiver is to be operated from a remote point.





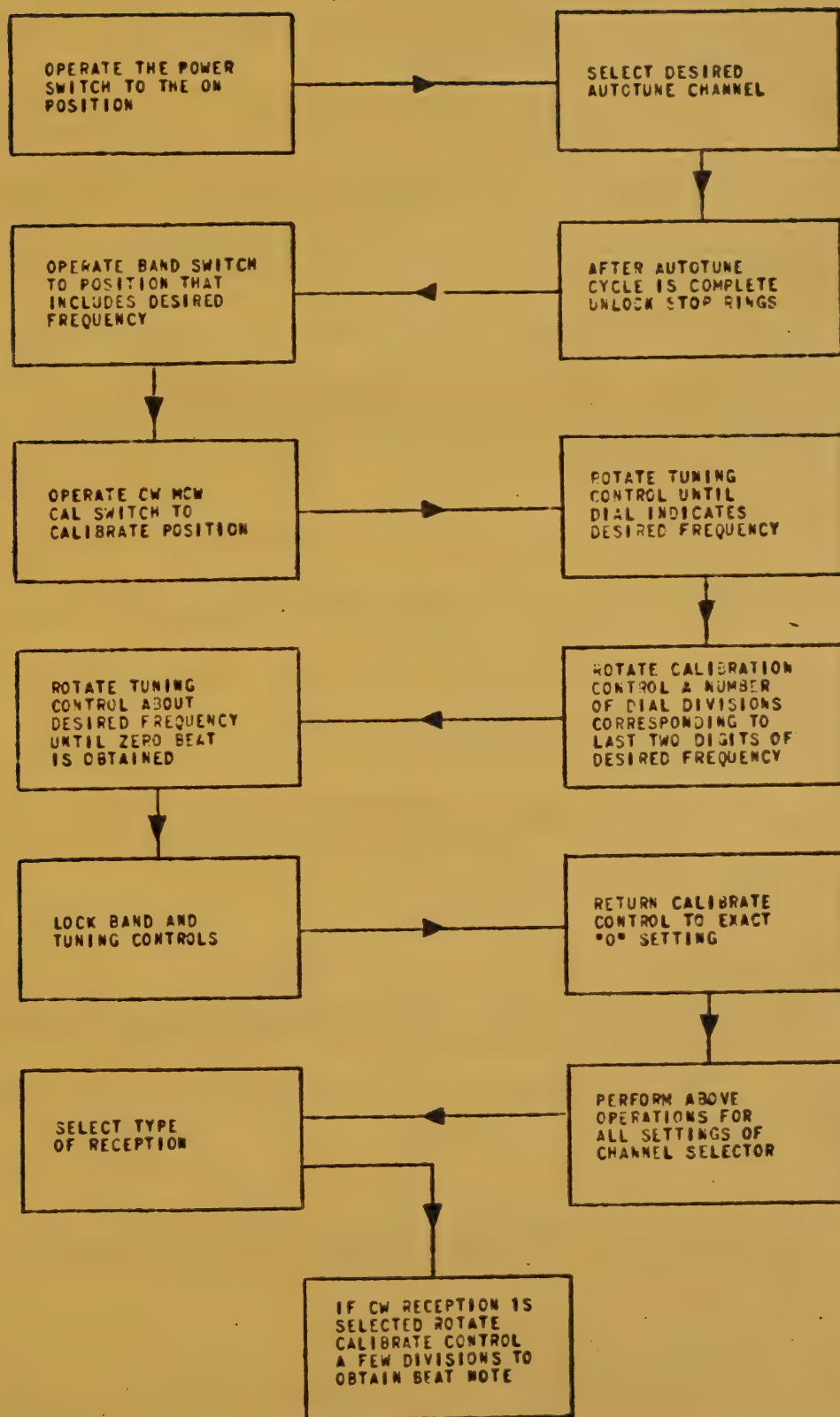


Figure 4.2. Operating Sequence Block Diagram



SECTION V  
MAINTENANCE

1. INSPECTION.

a. GENERAL. - This radio equipment has been constructed of materials considered to be the best obtainable for the purpose and has been carefully inspected and adjusted at the factory to reduce maintenance to a minimum. However, a certain amount of checking and servicing will be necessary to maintain efficient and dependable operation. The following sections have been set up to aid in the checking of the equipment. The inspection procedure is divided into three periods, namely, pre-flight inspection, daily inspection and 100 hour inspection.

b. PRE-FLIGHT INSPECTION. - The purpose of the pre-flight check is to make certain that the equipment is functioning properly and that all parts are securely fastened.

(1) VISUAL INSPECTION.

(a) Check the Autotune locks on the BAND switch and the TUNING control and make certain that both are tight.

(b) Check the antenna and the ANTENNA terminal connection.

(c) Check the mounting base and make certain that the base is securely fastened to the structure of the aircraft and grounded.

(d) Check the condition of the securing clamps on the mounting base and the safety wires that hold the clamp nuts in place.

(e) Check the remote control unit and make certain that the unit is securely fastened.

(f) Check all of the interconnecting wires. If necessary, hand tighten all of the wire plug locking rings. Inspect the interconnecting wires for breaks and loose connections at the plugs.

(g) Check the headphones for loose or broken wires.

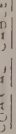
(h) Make all other checks that may aid in accomplishing the "purpose" of this inspection.

(2) OPERATION CHECK. - Before each flight the operation of the receiver should be checked. The following operational check will indicate whether or not the receiver is operating normally.

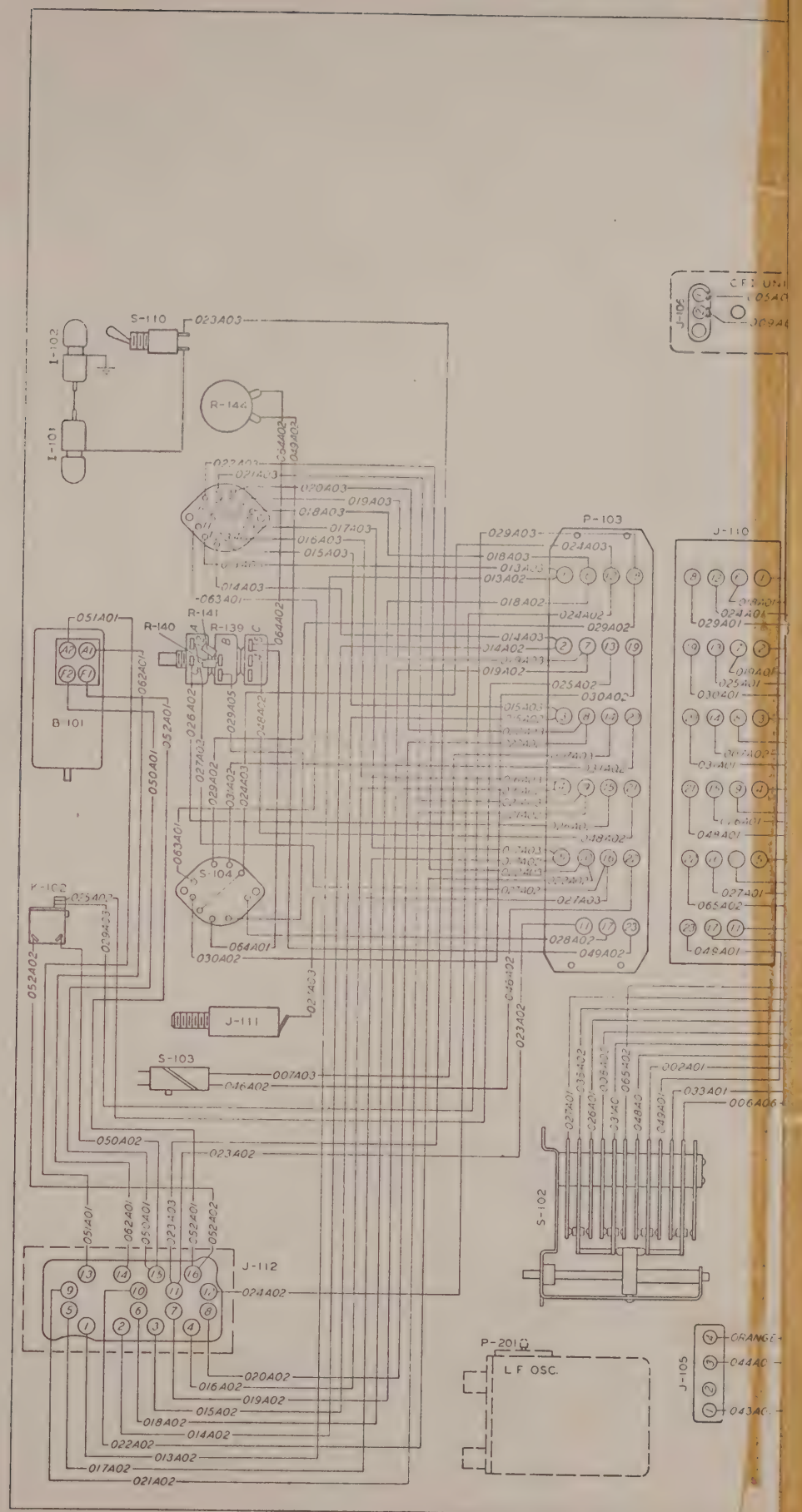








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## MAINTENANCE

(a) Operate the ON-OFF switch to the ON position and allow a few seconds for the tubes to warm up.

(b) Advance the VOLUME control for the desired audio output.

(c) Select each of the ten frequency channels and listen for a signal of known strength. If a signal is heard on each of the frequency channels the receiver may be assumed to be operative.

### c. DAILY INSPECTION.

(1) GENERAL. - The daily inspection is designed to determine, in general, the condition of the complete equipment and to detect any aggravated conditions, maladjustments, breaks, etc.

(2) VISUAL INSPECTION. - The visual inspection for the daily inspection is the same as for the pre-flight check. Refer to paragraph 1. b. (1).

### (3) OPERATIONAL INSPECTION.

#### (a) PROCEDURE.

1. Check the receiver for sensitivity against stations of known frequency and signal strength on all channels.

2. Check the controls of the remote control unit.

3. Make certain the dynamotor is running smoothly.

### d. 100 HOUR INSPECTION.

(1) GENERAL. - This inspection involves removal of the chassis and should be a thorough and searching visual and operating inspection designed to determine the amount of service that is required and to detect maladjustments and early stages of deterioration of components.

(2) REMOVING RECEIVER CHASSIS. - The first step in the procedure is to remove the receiver from the mounting base. Unfasten the safety wires on the two nuts at the bottom of the front panel and loosen the nuts. Slide the unit forward until the plug and plug receptacle are disengaged. Lift the unit from the mounting rack and place on a bench. Disengage the Dzus fastener at the rear of the cabinet and pull the unit forward to remove the chassis from the cabinet.



## MAINTENANCE

(a) REMOVING THE DYNAMOTOR UNIT. - To remove the dynamotor from the receiver chassis, pull out the four snap fasteners at the dynamotor base. The dynamotor will lift out of the plug-in connector located in the base.

### (b) VISUAL INSPECTION.

1. With the dynamotor removed from the equipment, remove the dynamotor end shields and check the commutator and brushes for wear.

2. Check the tubes to make certain that all are tight in the sockets.

3. Check all the moving parts in the receiver and any other parts that may have become loose due to vibration.

4. Check the capacitors, resistors and other components for corrosion and deterioration.

5. Check all of the relay and switch contacts for corrosion and pits.

### (3) OPERATIONAL INSPECTION.

#### (a) EQUIPMENT REQUIRED.

1. Power supply. - 26 volts dc.

2. Mounting base with plug.

3. Connecting cable.

4. Headphones.

5. Signal generator.

6. Dummy antenna - 10 ohms, 100 mmf.

7. Output meter.

(b) MANUAL OPERATIONAL CHECK. - Make certain all the controls are operating properly. Check the CHANNEL, TUNING, CALIBRATE, VOLUME, CW MCW-CAL controls on the front panel.

#### (c) AUTOMATIC OPERATION OPERATIONAL CHECK.

1. Plug the receiver unit into the mounting base and connect the cable to a 26.5 volt dc supply.





## MAINTENANCE

2. Plug the headphones into the PHONE jack.
3. Connect a ground to the receiver mounting base.

### (d) CHECKING PROCEDURE.

1. Lock the TUNING and BAND switch controls.
2. Rotate the ON-OFF switch to the ON position and select channel number one with the CHANNEL selector control.
3. Select each of the ten channels after the Autotune cycle has been completed for each channel.

### (e) RECEIVER SENSITIVITY CHECK.

1. Connect a signal generator to the ANTENNA terminal of the receiver through a dummy antenna that consists of 10 ohms non-inductive resistance and 100 mmf of capacitance in series.
2. Connect an output meter to the receiver output.
3. Rotate the ON-OFF switch to the ON position and rotate the CHANNEL selector switch to channel number 1.
4. Check the sensitivity of the receiver against the table of "Sensitivity vs Frequency" given below.
5. Check the sensitivity on all ten channels.

SENSITIVITY vs FREQUENCY			
FREQUENCY (mc)	BAND	INPUT (uv)	OUTPUT (mw) (30% mod)
2.0	A	2.4	100
3.0	B	2.0	100
4.5	C	2.5	100
7.0	D	2.5	100
10.0	E	2.3	100
15.5	F	2.5	100



## MAINTENANCE

### 2. VACUUM TUBES.

#### a. PRECAUTIONS FOR SATISFACTORY TUBE LIFE.

- (1) Before any tube is removed from the receiver, make certain that the ON-OFF switch is in the OFF position.
- (2) The external power supply must not exceed 28 volts. (Normal voltage 26.5 volts dc.)
- (3) Operate all of the tubes within 5% of the rated voltages.
- (4) Do not exceed the rated plate current of any of the tubes during normal operation of the equipment.

#### b. TUBE REPLACEMENT PRECAUTIONS.

- (1) All tubes are removed by pulling straight out of the sockets.
- (2) Before a tube is replaced, make certain that the type of tube is correct for the socket into which it is being placed.
- (3) When replacing the tubes, properly orient the tube pins with respect to the socket and push into place.

c. REPLACEMENT OF TUBES. - Before a tube is discarded, make certain that the tube is at fault and that the trouble is not a loose or broken connection in the equipment. When a tube is known to be defective it should be disposed of immediately so that the tube will not become mixed with good tubes from general stock. Discard all tubes with open heaters, shorted or noisy elements, low emission or any other defect which would cause faulty operation of the equipment. If the tubes in the equipment have been continually in use for a year, replace all the tubes. A marked improvement in performance of the equipment is usually noticeable after the weak tubes have been replaced.

#### NOTE

ALL TUBES OF A GIVEN TYPE SUPPLIED WITH THE EQUIPMENT SHALL BE CONSUMED PRIOR TO EMPLOYMENT OF TUBES FROM GENERAL STOCK.

### 3. TROUBLE LOCATING IN INSTALLED EQUIPMENT.

a. GENERAL. - In case of trouble, look for simple causes first. Analyze and isolate the difficulty before attempting to remove or dismantle any part





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of the equipment. A few moments of thought and study of the various possible causes of failure may save hours of haphazard labor. Radio equipment is often damaged by needless disassembly and removal of parts.

b. LOCATING TROUBLE. - Before the receiver unit is removed from the aircraft the trouble should be determined if possible. The checks in the following trouble locating chart and block diagram should be made to locate the trouble which can be repaired without removing the receiver unit. If the trouble cannot be located and repaired by the following checks, the receiver unit must be removed from the aircraft and taken to a repair station.

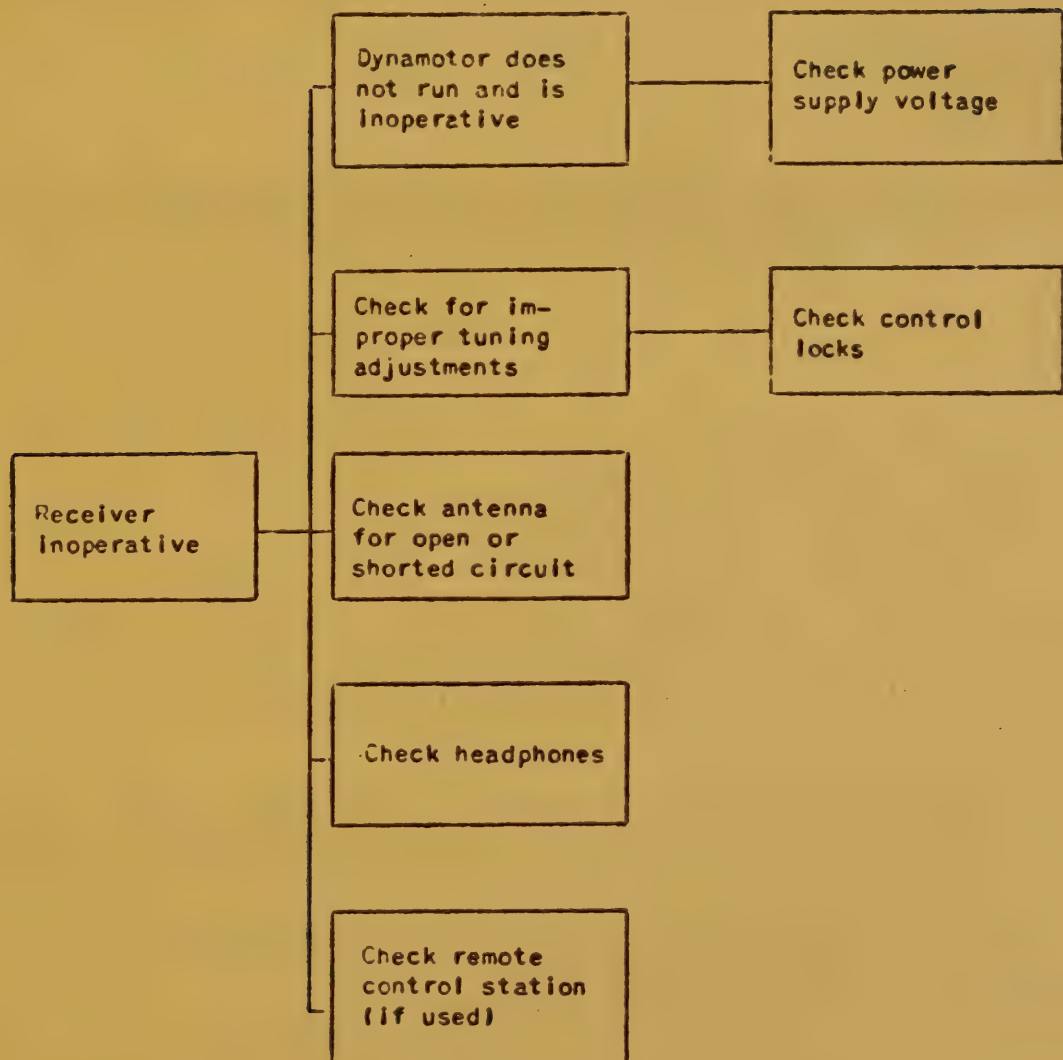
### (1) INSTALLED EQUIPMENT TROUBLE LOCATING CHART.

Symptoms	Possible Cause of Trouble
Autotune mechanism does not operate and dynamotor does not rotate.	1. No input voltage. 2. Power source voltage too low.
No signal received.	1. Antenna open or short circuit. 2. Defective headphones. 3. Improper tuning.
Receiver inoperative on one or more channels.	1. Improper tuning or a control or controls unlocked.
Receiver operative but remote station inoperative.	1. Defective headphones, cable plugs, wiring or switch at the remote unit.



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### (2) INSTALLED EQUIPMENT TROUBLE LOCATING BLOCK DIAGRAM.







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### (3) REMOVING RECEIVER UNIT FROM THE MOUNTING BASE.

(a) Remove the safety wire and loosen the nuts that clamp the unit to the shock mounting base.

(b) Using the handles on the front panel, pull the unit straight forward to release the unit from the plug-in connections and rear mounting studs.

### 4. TROUBLE LOCATING AT REPAIR STATION.

a. PRELIMINARY CHECKS. - The following preliminary checks may be easily performed to locate trouble in the receiver. The checks consist primarily of visual inspections of control positions and equipment performance.

#### (1) EQUIPMENT REQUIRED.

(a) Power supply. - 26.5 volts dc.

(b) Power supply cable and plug.

(c) Voltmeter.

Range: 0-10, 0-250 volts dc.

(d) Ohmmeter.

Range: 0-10, 0-100,000, 0-5 megohms.

(e) Spare tubes.

(2) REMOVING CHASSIS FROM CABINET. - When the receiver has been removed from the shock mounting base, proceed as follows to remove the chassis from the cabinet.

(a) Rotate the Dzus fastener, located on the rear of the cabinet, a half revolution counterclockwise.

(b) Using the two handles on the front panel, pull the chassis from the cabinet.

### (3) PRELIMINARY TROUBLE LOCATING CHART.



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Symptoms	Possible Source of Trouble
Equipment dead	<ol style="list-style-type: none"> <li>1. Defective ON-OFF switch</li> <li>2. Defective primary power control relay K-101</li> <li>3. Broken connection in primary circuit</li> </ol>
Autotune operative but dynamotor does not run	<ol style="list-style-type: none"> <li>1. Defective motor brushes</li> <li>2. Dynamotor windings open</li> <li>3. Open circuit in wiring</li> </ol>
Receiver operative but will not change channels electrically	<ol style="list-style-type: none"> <li>1. Defective relay K-103</li> <li>2. Defective CHANNEL selector switch</li> <li>3. Autotune motor brushes are not making proper contact</li> <li>4. Autotune motor winding open</li> </ol>
No signals received	<ol style="list-style-type: none"> <li>1. Defective tubes</li> <li>2. Defective relays</li> <li>3. No plate voltage</li> <li>4. Defective circuits</li> </ol>
No plate voltage	<ol style="list-style-type: none"> <li>1. Defective dynamotor</li> <li>2. Shorted filter or bypass capacitor</li> <li>3. Open filter choke</li> <li>4. Defective relay</li> </ol>





## MAINTENANCE

(Continued)

Symptoms	Possible Source of Trouble
Receiver noisy	<ol style="list-style-type: none"> <li>1. Defective tube</li> <li>2. Loose wiring connection</li> <li>3. Open filter or bypass capacitor</li> <li>4. Defective relay contacts</li> </ol>
Oscillation in receiver	<ol style="list-style-type: none"> <li>1. Open bypass capacitor</li> <li>2. Defective ground connection</li> <li>3. Defective tube</li> <li>4. Defective shielding</li> </ol>
Signals weak	<ol style="list-style-type: none"> <li>1. Weak tubes</li> <li>2. Low voltages</li> <li>3. Improper tuning</li> <li>4. Misalignment of circuits</li> </ol>

### b. TROUBLE LOCATING STAGE BY STAGE.

#### (1) TEST EQUIPMENT REQUIRED.

(a) Audio oscillator. - 1000 cps.

(b) Signal generator. -

Range: 400 kc to 20 mc.

(c) Capacitor. - .01 mf (approximate).

(2) PROCEDURE. - The installed equipment trouble locating block diagram shows the procedure recommended for the checking for trouble in the receiver. With the receiver trouble symptom in mind, study the block diagram and considerable time may be saved in locating the trouble.



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(a) ISOLATING THE TROUBLE. - When the trouble cannot be located in the preliminary checks under Paragraph 3, the stage by stage procedure in the following paragraphs will locate the stage in which the trouble exists.

### 1. AUDIO STAGES.

a. Connect the output of an audio oscillator through a .01 mf capacitor to the plate of the second audio amplifier tube (Terminal 3 on X-108).

b. Connect the audio oscillator ground lead to chassis ground.

c. Adjust the audio oscillator to approximately 1000 cps, with maximum output.

d. Adjust the VOLUME control to maximum position.

e. Operate the CW MCW-CAL switch to the MCW-CAL position.

f. Turn the audio oscillator and receiver on. The 1000 cps signal should be heard in the headphones if the circuits are operative (allow enough time for the tubes to reach the operating temperature).

g. Using the procedure in the above steps, connect the audio oscillator output lead to the following check points and in the following sequence:

- (1) Grid of second audio tube, (Terminal 5 on socket X-108).
- (2) Plate of audio driver tube, (Terminal 8 on socket X-107).
- (3) Grid of audio driver tube, (Terminal 4 on socket X-107).
- (4) Cathode/plate of noise limiter tube, (Terminal 4/5 on socket X-110).

### NOTE

If a stage is defective the trouble will be between the point where no signal was heard and the last point at which the signal was heard.

2. DETECTOR, AVC AMPLIFIER AND NOISE LIMITER. - If the signal is heard in the headphones when the output of the audio oscillator is fed to the cathode/plate of the noise limiter tube, it is evident that the audio stages are operative and that the trouble must be in a stage preceding this point. These stages may be checked in much the same manner as the audio





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stages were checked. Use a signal generator in place of the audio oscillator and proceed as follows:

- a. Connect the output lead of the signal generator through a .01 mf capacitor to the i-f coil side of the crystal detector CR-101.
- b. Connect the ground lead of the signal generator to the chassis ground.
- c. Adjust the receiver VOLUME control to the maximum position.
- d. Turn on the receiver and signal generator.
- e. Make certain the CALIBRATE dial is in the 0 position.
- f. Adjust the signal generator to 500 kc and the signal will be heard if the circuits are operative.

3. I-F AMPLIFIER STAGES. - Using the same procedure as in the above steps b., c., d., e., and f., connect the output from the signal generator to the following check points in the following sequence:

- a. Plate of tube V-104 (Terminal 8 on socket X-104).
- b. Grid of tube V-104 (Terminal 4 on socket X-104).
- c. Plate of tube V-103 (Terminal 8 on socket X-103).
- d. Grid of tube V-103 (Terminal 4 on socket X-103).
- e. Plate of tube V-102 (Terminal 8 on socket X-102).
- f. Grid of tube V-102 (Terminal 4 on socket X-102).

4. OSCILLATOR, FREQUENCY MULTIPLIER AND MIXER STAGES. - If the signal of the signal generator is heard through the I-F amplifier stages, the oscillator, frequency multiplier and mixer stages may be checked by leaving the signal generator connected to the grid of the mixer tube as in the above paragraph under step f. and adjusting the signal generator and the receiver TUNING dial to a like frequency. The signal will be heard if these stages are operative.



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### CAUTION

Do not even attempt to loosen a screw in the high or low frequency oscillator units before carefully reading the instructions under paragraph 4., d. in this section.

5. R-F AMPLIFIER STAGE. - If a signal is heard when the stages in the above paragraph are checked, the r-f amplifier stage may be checked with the same receiver and signal generator adjustment. Proceed as follows:

a. Connect the output of the signal generator to the plate of the r-f amplifier tube, V-101 (Terminal number 8 on socket X-101).

b. Grid of the r-f amplifier tube, V-101 (Terminal number 4 on socket X-101).

c. Antenna connection on the front panel.

6. LOW FREQUENCY OSCILLATOR. - If the receiver operates normally when the CW MCW-CAL switch is in the MCW-CAL position but there is no beat frequency when the switch is in the CW position or if no zero beat can be obtained between the 100 kc check points from the cfi oscillator when the CALIBRATE dial is rotated, the low frequency oscillator unit or circuits are inoperative. (See CAUTION under above Paragraph 4.)

7. CFI UNIT. - If the receiver operates normally but no 100 kc check points can be heard when the cfi unit is turned on by the CALIBRATE dial, the cfi unit or circuits are inoperative.

g. TROUBLE LOCATING IN A STAGE FOUND INOPERATIVE. - When trouble is known to exist in the high or low frequency oscillator units, refer to Paragraph 4., d. in this section for the procedure to be followed in replacing oscillator. When trouble is known to exist in any other stage or circuit, use the following procedure to locate the trouble:

(1) Replace the tube with one of the same type that is known to be in good condition and check to see if the trouble is corrected.

(2) Measure the voltage at the tube sockets. Incorrect voltage readings will indicate defective wiring or components.

(3) Check the capacitors for an open or shorted condition. A shorted capacitor usually will cause improper voltages to exist and may also cause resistors and other components to heat excessively. An open capacitor may





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be located by shunting the capacitor that is suspected with a test capacitor of the same value. An open capacitor will cause noise, oscillation or no signal to be heard.

(4) With the receiver turned off, measure the resistance of both the fixed and variable resistors in the circuit.

(5) With an ohmmeter and a schematic drawing of the circuit, check the continuity of the wiring, coils, transformers, relay contacts and relay coils.

(6) Replace any components found defective in the above checks and operate the receiver to determine if the trouble is corrected.

### d. HIGH OR LOW FREQUENCY OSCILLATOR.

#### CAUTION

Do not attempt to disassemble any part of the high or low frequency oscillators until the trouble is definitely proven to exist within the sealed cover. Each oscillator unit was accurately calibrated when installed at the factory and if a unit is loosened or removed from the equipment the calibration will be destroyed.

#### (1) OPERATIONAL CHECK.

(a) EQUIPMENT REQUIRED. - Receiver containing a beat frequency oscillator and having a frequency range of 450 to 550 kc to 2000 to 3000 kc.

#### NOTE

Any frequency measuring instrument may be used to determine if the oscillator unit is operative.

(b) PROCEDURE. - The oscillator unit should be checked while still in the receiver before disassembling any part of the unit. To check the unit proceed as follows:

1. Measure the plate and heater voltage at the connector jack to make certain the voltages are correct.

2. Unsolder and remove the wire from terminal number 4 on the connector jack.

3. Solder a short piece of insulated wire to the above terminal.



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4. Connect an insulated wire to the antenna terminal of the test receiver.

5. Twist the insulated wire from the receiver around the wire that is soldered to the oscillator unit connector jack but do not make a connection to the wire.

6. Turn the receiver and test receiver on.

7. Operate the MCW-CW switch to the MCW position for checking the high frequency oscillator; check the low frequency oscillator with the CALIBRATE dial turned on.

8. Tune the test receiver from 450 to 550 kc for checking the low frequency oscillator unit or 2000 to 3000 kc for the high frequency oscillator unit. If no signal can be heard, the oscillator unit is defective.

### (c) REPLACEMENT OF TUBE.

1. Remove the four seal headed screws which hold the tube cover to the unit and lift the tube cover off.

### CAUTION

Hold the oscillator unit to remove strain when the tube is pulled out and a tube is being inserted.

2. Insert a tube of the proper type that is known to be in good condition.

3. Before replacing the tube cover, turn the receiver on to ascertain if the trouble is corrected.

4. If the trouble is corrected, replace the tube cover. Use new rubber gaskets for the screws. Gasket - Collins part no. 502 4284 001.

5. Check the oscillator unit frequency for changes caused by the tube now in use.

### (d) REPLACEMENT OF HF OSCILLATOR UNIT.

1. Set the TUNING control at 3.5 mc and the BAND switch "B".

2. Remove the front panel of the receiver.





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3. Remove the dial from the Autotune head in front of the oscillator unit.

4. Remove the Autotune head.

### CAUTION

Do not move the line shaft or the gears in the Autotune head just removed.

5. Disconnect and remove the CFI unit from the receiver. The CFI unit is bolted to the main chassis by four captive screws which are observed from the bottom of the receiver.

6. Loosen the Bristo set screws in the collar connecting the oscillator tuning shaft.

7. Unscrew the screws which hold the oscillator unit to the Autotune casting and remove the defective oscillator through the space made by the removal of the CFI unit.

8. Install the new oscillator unit in the receiver using the screws that were removed from the front plate of the defective unit.

9. Replace the CFI unit and restore the connections.

10. Reassemble the Autotune head, dial and front panel but do not tighten the Bristo screws in the collar which fastens to the oscillator unit shaft. (The dial must be set at 3.5 mc band "B" before reassembling).

### CAUTION

Do not operate the Autotune mechanism until all of the following adjustments have been made with manual tuning.

11. Unlock both Autotune controls.

12. Operate the CALIBRATE dial to the "0" position.

13. Short or block the calibrate switch to allow the l-f oscillator and the CFI unit to operate.

14. Tune the test receiver to 3.0 mc on band "B".

15. Couple the test receiver to terminal number 4 on the h-f oscillator and tune the oscillator until a beat note is heard in the test receiver.



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The oscillator must be turned by grasping the oscillator shaft with a thin pliers.

16. While listening to the output of the 5LH-3 receiver, tune the h-f oscillator to zero beat with the CFI signal which should be heard at 3.5 mc.

17. Turn the TUNING dial to 3.5 mc and lock the set screws in the coupling collar on the oscillator shaft. (The incoming signal is .5 mc higher in frequency on this band therefore the dial would be set at 3.5 mc when the oscillator is at 3.0 mc).

18. With the tuning dial set at 3.5 mc there should be approximately 1/32 inch clearance between the fixed stop and the movable stop on the tuning coil platform, see Item A figure 5-1. If this clearance is not 1/32 inch, the set screws in the large gear, Item (B) figure 5-1 on the front end of the tuning shaft should be loosened and the clearance between the stops adjusted by inserting a 1/32 inch shim between the stops after which the set screw should be tightened and the shim removed.

19. Before the Autotune mechanism is operated, tune manually from one end of the dial to the other to make certain the oscillator unit is properly adjusted. If not properly adjusted, the tuning slug in the oscillator will hit the tuning slug end stops and the Autotune gears may become stripped or the equipment damaged. Do not attempt to "force" the tuning mechanism.

20. It may be necessary to re-align the rf and the band pass stages for maximum results. See paragraph 8. d. for alignment procedure.

21. Check and reset the Autotune controls for all of the channels.

### (e) REPAIRING OSCILLATOR UNITS.

#### CAUTION

Do not attempt to disassemble and/or repair either the high or low frequency oscillator unit unless complete alignment equipment, as outlined in paragraph 4. d. (f) in this section, is available and the alignment procedure is thoroughly understood.

1. Remove the unit from the receiver as outlined in paragraph (d).

2. Remove the eight seal headed screws which fasten the tube cover and connector plug to the unit cover.





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3. Remove the tube cover and pull the tube and plug from the unit.
4. Remove the three seal headed screws on the rounded end of the unit which fasten the unit cover to the front plate. Remove the unit cover.
5. Check all the components and replace any that are found defective.
  - a. REPLACING COMPONENTS. - To replace the grid inductor, tuning slug, lead screw or rotary seal, the unit must be further disassembled.
    - (1) Remove the three seal headed screws from the countersunk holes in the front plate.
    - (2) Remove the front plate, lead screw and tuning slug with care to avoid losing the end thrust ball bearing.
    - (3) Unsolder the wires from the grid inductor and remove the three screws which hold the grid inductor to the end plate.
    - (4) To replace the rotary seal, loosen the two Bristo set screws in the rotary seal collar and pull this section of the rotary seal off the threaded end of the lead screw, after the tuning slug has been removed. The other section of the rotary seal is pressed into a seat on the front plate and may be pried out.
    - (5) When the grid inductor is replaced, leave the three screws slightly loose.
    - (6) If the lead screw or the rotary seal is replaced, press the rotary seal onto the lead screw but do not tighten the Bristo set screws into the collar.
    - (7) Press the remaining section of the rotary seal into the countersunk seat on the front plate.
    - (8) Place a few drops of Standard Oil of N. J. BE-19584 (AN-O-4) on the lubricator wick.
    - (9) Place a small portion of grease on the thrust end of the lead screw and the ball bearing before inserting the tuning slug into the tuning inductor.
    - (10) Loosen the lock nut on the front bearing and unscrew the bearing a few revolutions.
    - (11) Grease the bearing slightly and replace the end plate.



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(12) Replace the rubber gaskets on the three screws and tighten the screws firmly.

(13) Space the grid inductor evenly around the tuning slug and tighten the screws into the grid inductor base.

(14) Solder the wires that were disconnected in step (3) above, into place.

(15) Adjust the front bearing and tighten the lock nuts. Repeat this procedure until no end play can be felt and the lead screw runs smoothly and does not bind at any position of the tuning slug.

(16) Adjust the rotary seal collar, by sliding the collar until the spring is compressed to one quarter of the extension and tighten the two Bristo set screws into the rotary seal collar.

(17) Assemble the cover, plug, tube and tube cover, using new rubber gaskets on both the covers and screws. The unit must now be aligned and tested.

(f) OSCILLATOR ALIGNMENT. - The alignment of the high and low frequency oscillator units is important for proper operation of the receiver. An oscillator must be aligned after being disassembled.

### 1. EQUIPMENT REQUIRED.

a. Frequency measuring instrument.

(Recording type preferred)

RANGE: 450 to 550 kc - 2000 to 3000 kc.

b. Oven - refrigerator

Temperature range: Adjustable from  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) to  $+70^{\circ}\text{C}$  ( $+158^{\circ}\text{F}$ )

### 2. PROCEDURE.

a. Connect a 12 volt supply to terminals 1 and 2 of the connector plug.

b. Connect the positive voltage of a 250 volt supply to terminal number 3 and the negative voltage to terminal number 2 of the connector plug.





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c. Connect the frequency measuring instrument to terminal number 4 of the connector plug.

d. Attach an indicator knob and dial to the oscillator lead screw shaft.

e. Adjust the frequency measuring instrument for 450 kc for the low frequency oscillator (2000 kc for the high frequency oscillator) and rotate the oscillator dial to this frequency.

f. Note the dial setting and rotate the oscillator unit dial exactly five revolutions for the low frequency oscillator. The frequency should measure exactly 550 kc. (The high frequency oscillator unit output should measure exactly 3000 kc after the dial has been rotated exactly 10 revolutions).

g. If the frequency measures higher or lower, remove the cap screw that is located between the plug and the tube, on top of the unit and adjust the variable capacitor to compensate for the error.

h. Repeat steps e., f. and g. until the exact number of revolutions of the dial will cover the oscillator frequency range.

i. Remove the tube cover and place the unit in an oven that is at a temperature of  $+70^{\circ}\text{C}$  ( $+158^{\circ}\text{F}$ ) for several hours to dehydrate and age the components within the oscillator unit.

j. Replace the tube cover and cap screw to seal the unit.

k. Repeat the above steps a. to h. to check any variation which may have occurred.

l. Connect the oscillator unit as in the above steps a., b. and c. and place the unit in the oven-refrigerator. (The unit must be sealed.)

m. Run frequency and temperature charts at the high and low frequency end of the oscillator frequency range while slowly changing the temperature from  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) to  $+70^{\circ}\text{C}$  ( $+158^{\circ}\text{F}$ ).

n. If the frequency drifts more than plus or minus 1.0 kc, compensate for the drift by replacing the temperature compensating capacitors, with capacitors of a plus or minus temperature coefficient, whichever is required to correct the drift.



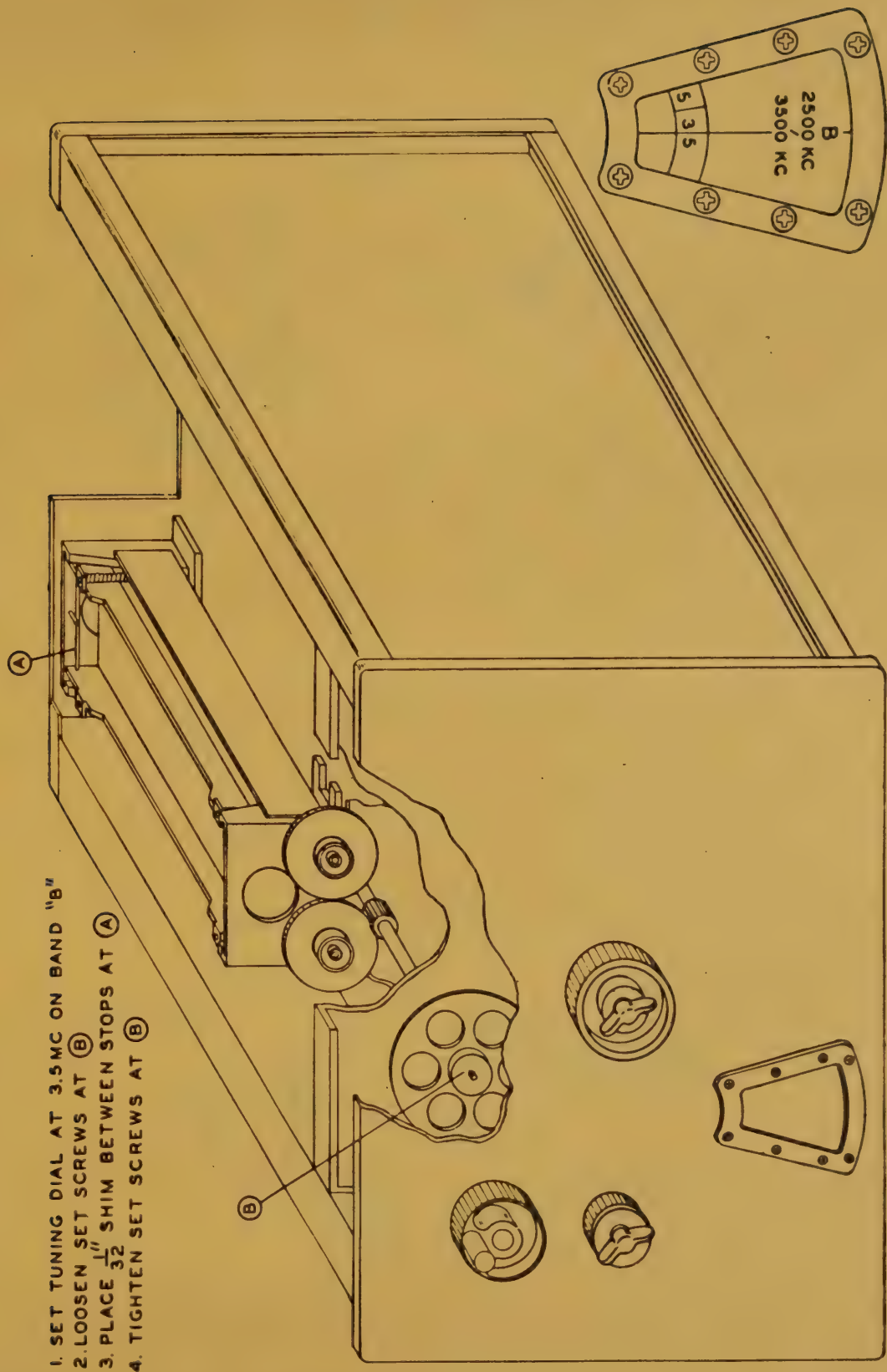


Figure 5-1 Oscillator Alignment







Figure 5-2 Disassembly View of HF Oscillator



Figure 5-3 Disassembly View of LF Oscillator



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o. When a change is made, repeat the above steps 1. to n. When the performance is satisfactory the unit may be installed in the receiver.

p. Install the hf oscillator in the receiver using instructions outlined in paragraph (d) REPLACEMENT OF HF OSCILLATOR UNIT.

### 5. REPLACEMENT OF DIAL LAMPS.

Each of the two dial windows on the front panel are illuminated by two twelve volt dial lamps. The receiver chassis must be removed from the cabinet to replace the dial lamps. Refer to paragraph 1. d. (2), in this section for the procedure to remove the chassis from the cabinet.

### 6. SPECIAL MAINTENANCE.

#### a. MECHANICAL ADJUSTMENT AND REPAIR.

##### (1) AUTOTUNE SYNCHRONIZATION.

##### (a) CONTROL UNIT.

1. Remove the control knobs and front panel from the receiver.
2. Loosen the locking collar on the seeking switch drive shaft with a Phillips screwdriver. (Refer to figure 5-4.) Do not remove the locking collar from the shaft.
3. Turn the locking collar clockwise, rotating the seeking switch breaker cam assembly until a sharp click is heard. This click is caused by the breaker contact arm dropping off the breaker points.
4. Apply a small amount of pressure counterclockwise to the locking collar to hold the breaker contacts snugly against the breaker point.
5. Maintaining condition under step 4., insert a number 10 Bristo wrench in the end of the drive shaft and turn the shaft counterclockwise to the limit of travel.
6. Without disturbing the setting, tighten the locking collar set screw. This locks the drive shaft to the seeking switch and completes the adjustment of the control unit.

##### (b) MULTITURN UNIT.

1. Insert a number 10 Bristo wrench into the end of the shaft of the cam drum of the multiturn unit. (Refer to figure 5-4.)





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8. Using the wrench, rotate the cam drum as far as possible in a counterclockwise direction.

9. While holding the cam drum as indicated in step 8., loosen the nut that is located on the end of the cam shaft by rotating the nut in a clockwise direction.

10. Again, using the Bristo wrench, rotate the cam drum as far as possible in a counterclockwise direction.

11. Tighten the nut. (Rotate in a counterclockwise direction.)

(c) SINGLETURN UNIT.

12. Insert the Bristo wrench into the end of the cam drum. (Refer to figure 5-4.)

13. Rotate the cam drum as far as possible in a clockwise direction.

14. Loosen the nut on the end of the cam shaft by rotating the nut in a counterclockwise direction.

15. Rotate the shaft as far as possible in a clockwise direction.

16. Tighten the nut.

Having completed the above adjustments, the Autotune mechanism will be properly synchronized. To check the synchronization, select an Autotune channel and note the position of the pawls in slots of the cam drums. At room temperature and with normal voltage applied to the motor the pawl should be approximately in the center of the slot on both units. After the synchronization has been checked and the mechanism is found to be operating properly, secure each item that has been loosened with a drop of liquid staking compound.

(2) AUTOTUNE REPAIR.

## CAUTION

Do not attempt to repair the Autotune mechanism until all methods of adjustment have been tried and have failed and the following operational checks have been performed.

(a) The following chart will assist in localizing trouble in the Autotune mechanism.



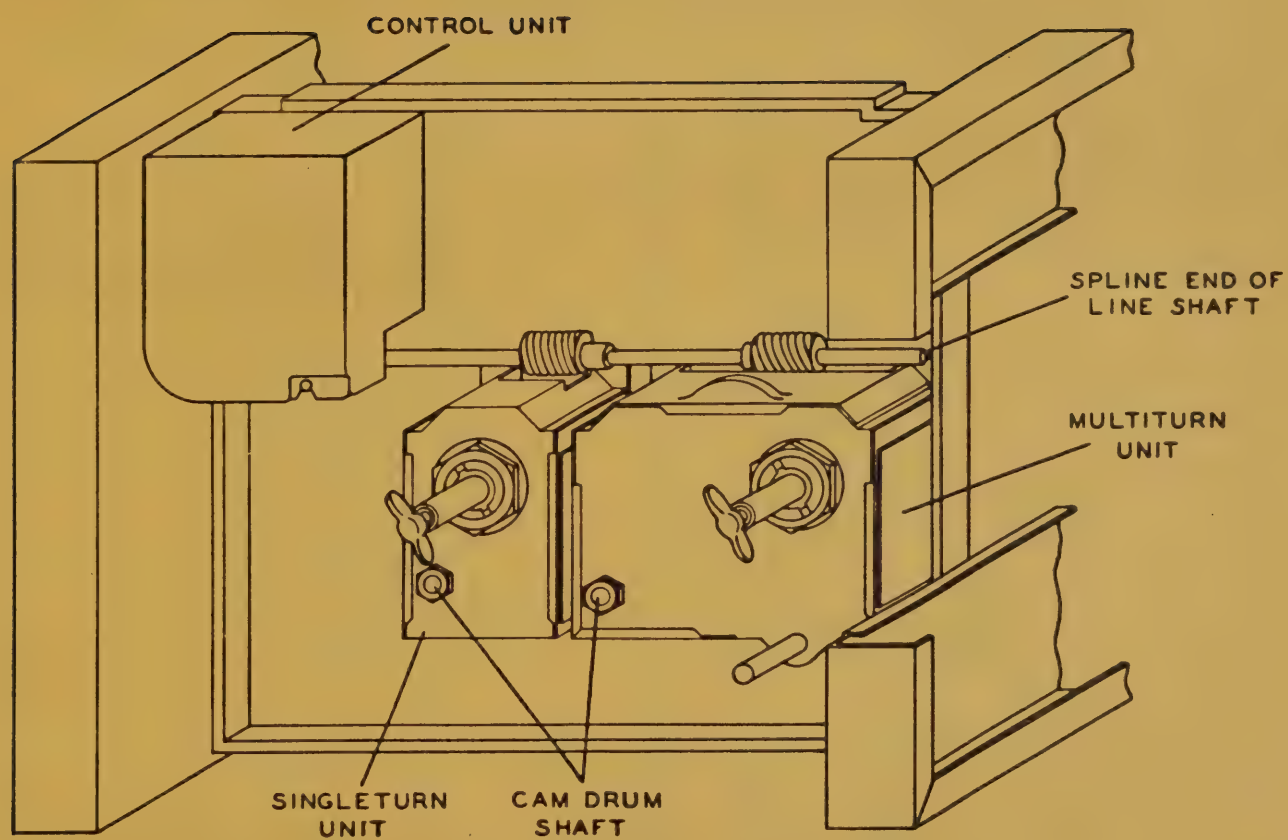


Figure 5-4 Autotune Synchronism Adjustments



Symptoms	Possible Source of Trouble	Remedy
Autotune system continues to run, re-cycling instead of reversing.	<ol style="list-style-type: none"> <li>1. Motor reversing switch S-109 not operating properly.</li> <li>2. Timing cam switch S-107 not operating properly.</li> <li>3. Motor does not reverse properly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean, readjust or replace switch.</li> <li>2. Clean and adjust switch.</li> <li>3. Replace motor.</li> </ol>
Erratic operation.	<ol style="list-style-type: none"> <li>1. Faulty operation of tuning switch cam.</li> </ol>	<ol style="list-style-type: none"> <li>1. Move seeking switch S-106 clockwise until the system begins to operate. The distance moved should be a noticeable amount (about 5 degrees) -Readjust star cam.</li> </ol>
Intermittent operation.	<ol style="list-style-type: none"> <li>1. Control unit contacts need cleaning.</li> </ol>	<ol style="list-style-type: none"> <li>1. Burnish the contacts to a smooth glossy surface.</li> </ol>
One unit will not position.	<ol style="list-style-type: none"> <li>1. Check defective unit by rotating locked unit control knob throughout the range of rotation attempting to engage the pawl.</li> </ol>	<ol style="list-style-type: none"> <li>1. If the pawl can be engaged by this means, resynchronization is probably necessary.</li> </ol>
Resynchronization does not remedy non-positioning of unit.	<ol style="list-style-type: none"> <li>1. Foreign matter in unit.</li> <li>2. Broken, unhooked or weak pawl spring.</li> <li>3. "Sticky" pawl.</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean unit.</li> <li>2. Reattach or replace.</li> <li>3. Can be made to operate in an emergency by working in a few drops of AN-O-4 oil into the pawl stack.</li> </ol>





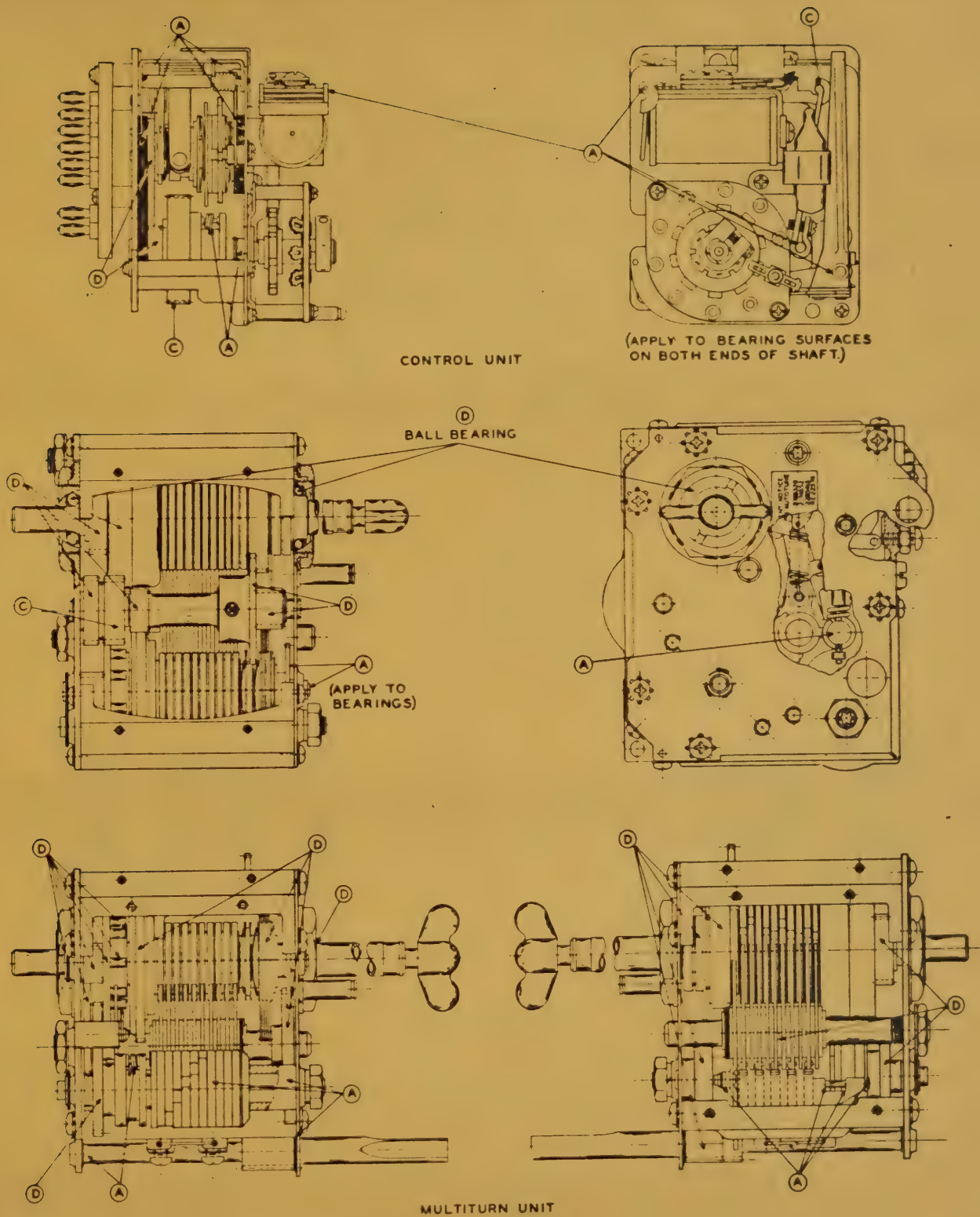
## MAINTENANCE

(3) RELAYS. - The relays in this equipment will not require service unless a short circuit has caused the contacts to be burned and pitted or damage has resulted from rough handling or improper treatment of the contacts. When it is necessary to clean and readjust a relay, do it carefully. Handle the relay as you would an expensive watch or fine meter. To clean the flat surface contacts, use only a crocus cloth or burnishing tool. Make certain all burns are removed from the contact points and that the surfaces are parallel. Make the contact adjustments carefully. Do not bend the contact spring arms. If the contacts do not close properly, bend the point tip end of the spring slightly. Check and re-check until the spacing is exactly what it should be. If a relay is badly damaged, replace the relay.

(4) SWITCH MAINTENANCE. - Maintenance of switches in this equipment primarily involves adjusting and cleaning. The adjustment and cleaning of the switches should follow the same procedure and use of the same materials as recommended for relays, paragraph 6. (3) above.

b. AUTOTUNE LUBRICATION. - Under ordinary operating conditions the Autotune mechanism will not require any lubrication for the lifetime of the equipment. If, however, the equipment is operated in a hot arid climate it may be necessary to lubricate the oilite bearings, replenish the oil supply of the oil retainers, and insert new worm gear lubricators into the holders once a year. The lubricants recommended are shown on the following lubrication chart:



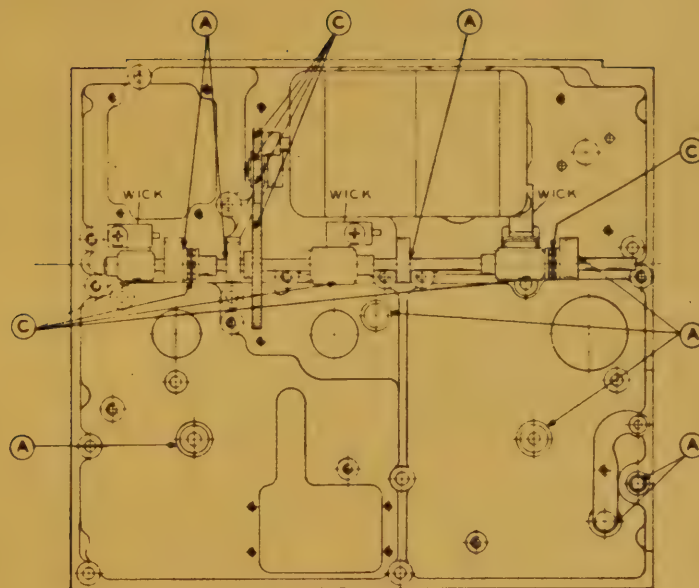


LUBRICATE ANNUALLY.  
EACH ARROW INDICATES A POINT OF LUBRICATION.  
LETTERS WITHIN BALLOONS CORRESPOND LUBRICANTS LISTED IN TABLE.

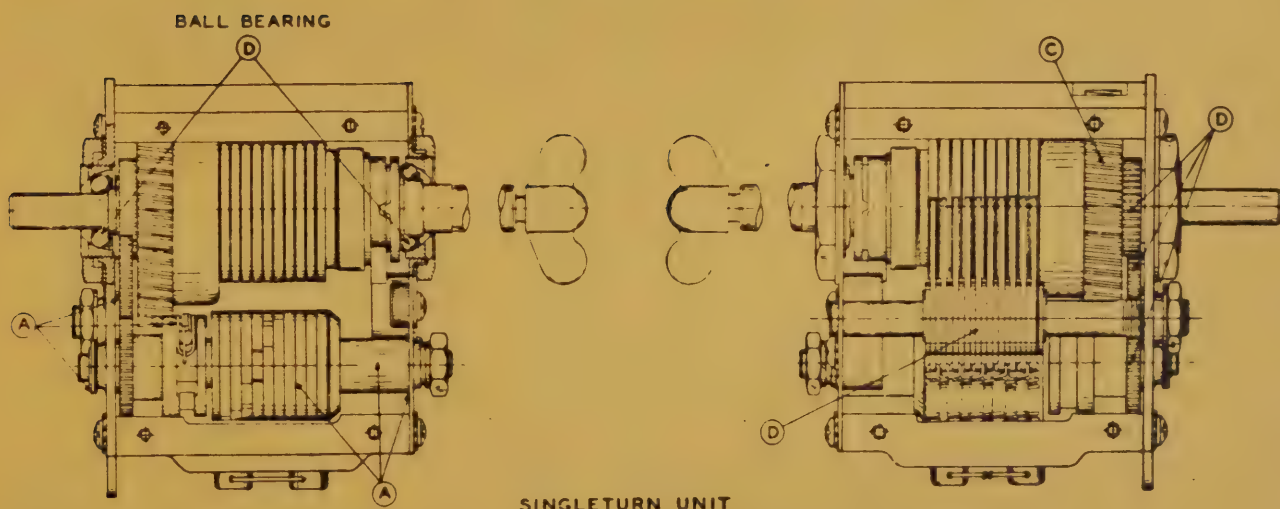
Figure 5-5A Lubrication Chart







AUTOTUNE CASTING



SINGLETURN UNIT

LUBRICATE ANNUALLY.  
EACH ARROW INDICATES A POINT OF LUBRICATION.  
LETTERS WITHIN BALLOONS CORRESPOND TO LUBRICANTS LISTED IN TABLE.

Figure 5-5B Lubrication Chart



LUBRICATION CHART  
LUBRICANT

ASSEMBLY	PART	CODE	MFG. AND MFG'S TYPE	LUBRICATION PERIOD	PROCEDURE
Autotune casting	Oilite bearings	A	Standard Oil Co. of N.J. BE-19584	Annually	Apply only amount bearing will retain.
Autotune unit	Pawl stacks	D	DOW Corning #7	Annually	Apply sparingly with camel hair brush. Remove excess lubricant.
Autotune unit	Felt Washers	A	Standard Oil Co. of N.J. BE-19584	Annually	Apply only amount bearing will retain.
Autotune unit	Spur gears	D	DOW Corning #7	Annually	Apply sparingly with camel hair brush, remove excess lubricant.
Autotune casting	Worm felt wick lubricator		Cities Service 7249M	Annually	Replace with new impregnated wicks.
Autotune casting	Worms, line shaft gear box	C	Cities Service PD-535A	Annually	Apply sparingly with camel hair brush, remove excess lubricant.
Slug plat- form drive	Gear box	B	Cities Service 51A	Annually	Repack if necessary.

Lubricant "C" may be used for lubricant "B" (Cities Service 51A) if extremely low temperature operation is not required.





## MAINTENANCE

### 7. DYNAMOTOR MAINTENANCE.

a. BRUSHES. - Replace brushes when less than 1/4 inch long, measured to the spring. The brush pressure is considered satisfactory if 1/4 inch or more of the spring extends out of the brush holder when the screw cap is removed and the brush is touching the commutator. New brushes may be sanded in with a strip of 4/0 sandpaper slipped under the brush and pulled back and forth over a suitable arc of the commutator. It is preferable that new brushes be run in for several hours at no load, or a light load, to obtain the proper fit before the machine is required to carry the full load. When brushes are removed for any reason, replace each brush in the same holder with the polarity marks face upward. If a brush pigtail is broken or loose in the brush or end cap, the current will have a tendency to go through the brush spring. This condition will cause the spring to over-heat, lose temper and fail to give the proper brush pressure.

b. ARMATURE. - The armature should be removed as follows:

- (1) Remove the covers from both ends of the dynamotor.
- (2) Remove the brush holder caps and brushes from both the high and the low voltage ends of the commutator.

### CAUTION

Notice that each brush is marked so that the brush may be replaced in the same holder and in the same position in the holder.

(3) Blow the dust and dirt from the shield and windings and disconnect the leads from the field coils to the brush holder on the high voltage end at the brush holder terminals.

(4) Remove the nuts from the clamp bolts and remove the end shield.

(5) Carefully remove the armature so as not to lose the end spacers.

c. COMMUTATOR. - A highly polished commutator is very desirable. A dark colored commutator should not be mistaken for a burned commutator. If the surface is smooth and polished and the commutation is satisfactory, the commutator should not be resurfaced. Slight sparking is not necessarily evidence of poor commutation. If the surface of a commutator is dirty, use a clean cloth moistened with a cleaning fluid, such as petroleum spirits, kerosene, or gasoline for cleaning and then wipe with a dry cloth. Keep the bearings and housing clean. Remove the end covers and blow the dust and





## MAINTENANCE

dirt out after each 300 hours of operation. This cleaning should also include removing the brushes and wiping the inside of the brush holders and the external surface of the brushes. If any mica of the undercut commutator extends up to the commutating surface, the mica should be undercut. For turning down the commutator or for extensive undercutting, remove the armature from the dynamotor and place in a lathe.

d. BEARINGS AND LUBRICATION. - The bearings are designed for long life but should be replaced if the bearings are loose on the shaft or if not otherwise operating satisfactorily. If the dynamotor is overhauled after each 300 hours of operation, no lubrication will be required between overhauls. To lubricate the bearings, remove the end cover and blow out the dust and dirt. Remove the screws that hold the end shield bearing retainer. Remove the retainer, being careful not to lose any washers from the end of the shaft. Clean out all the old grease. Apply three or four drops of light machine oil to the balls and repack the outer side of the bearing with a small amount of grease. Keep dirt from entering the housing and do not allow grease or oil to drop onto the commutator. Replace the washers and the end shield bearing retainer and cover. If the bearings are to be replaced, it will be necessary to remove the armature. If a puller is not available to remove the bearings, clamp the outer race firmly in a vice and drive the bearing off the shaft by holding a punch against the end of the shaft and tapping the punch lightly with a hammer. Shimming should be done using washers equally divided at both ends. End play of approximately .015 inch maximum is permissible. Whenever a bearing is removed from the housing, wipe the housing with a clean cloth and lubricate the housing sparingly with light machine oil. The inner race fits the shaft with a light press fit and some selection of bearings may be necessary to find one that is not too loose. The outer race should have a sliding fit in the housing. A small piece of pipe with the end smooth and slightly larger than the shaft is useful to press a new inner race onto the shaft. Do not exert pressure on the outer race of a bearing that is being pressed onto the shaft. After replacing a bearing, reassemble the dynamotor and make certain that the armature revolves readily without binding.

e. TROUBLES. - The following chart lists the troubles most often encountered in the operation of a dynamotor and the causes and correction of each:



Symptoms	Possible Cause of Trouble	Remedy
Dynamotor stops or fails to start.	<ol style="list-style-type: none"> <li>1. Open or loose connections</li> <li>2. Shorted capacitor.</li> <li>3. Brushes not seating properly due to a dirty, sticky or worn condition.</li> <li>4. Poor commutation due to dirty, oily or rough commutator or high mica.</li> <li>5. Worn bearings causing armature to strike pole faces or connections.</li> <li>6. Defective armature.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten connections.</li> <li>2. Replace capacitor.</li> <li>3. Remove brushes from holders and clean thoroughly. Seat brushes with 4/0 sandpaper, replace worn brushes.</li> <li>4. Clean commutator and brushes. If commutator is rough, turn down commutator and undercut mica.</li> <li>5. Replace bearings.</li> <li>6. Replace defective armature.</li> </ol>
Excessive arcing at the brushes.	<ol style="list-style-type: none"> <li>1. Poor commutation due to dirty, oily or rough commutator.</li> <li>2. Brushes not seating properly due to a dirty, sticky, or worn condition or a twisted pigtail.</li> <li>3. Brush spring weak or defective.</li> <li>4. Short between commutator bars.</li> <li>5. Open in armature coil.</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean commutator and brushes. If commutator is rough, turn down with a lathe and undercut mica.</li> <li>2. Clean brushes, untwist pigtail connector or replace brush assembly.</li> <li>3. Replace brush assembly.</li> <li>4. Clean slots or replace armature.</li> <li>5. Replace armature.</li> </ol>
Rapid wearing of brushes.	<ol style="list-style-type: none"> <li>1. High mica causing excessive arcing.</li> <li>2. Dirty commutator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Turn down commutator on a lathe and undercut mica.</li> <li>2. Clean commutator and brushes.</li> </ol>
Electrical noise in receiver.	<ol style="list-style-type: none"> <li>1. Sparking at commutator resulting from shorted or open capacitor or connection.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace capacitor. Tighten connections.</li> </ol>
Mechanical noise and vibration.	<ol style="list-style-type: none"> <li>1. Armature striking internal wiring.</li> <li>2. Armature.</li> <li>3. Worn bearings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Rearrange internal wiring.</li> <li>2. Replace bearings.</li> <li>3. Replace bearings.</li> </ol>





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f. ARMATURE WINDING TEST. - Overheating, reduced speed, excessive arcing at the brushes or low output voltage indicates that an armature winding may be shorted. When one or more of the above conditions exists, measure the resistance between pairs of adjacent commutator bars, particularly on the high voltage end of the commutator. A reading between one pair of bars which is more than seven per cent higher or lower than the average of readings between other pairs of bars indicates an open or shorted winding.

### 8. RECEIVER ALIGNMENT.

a. GENERAL. - The following equipment is required to align the receiver r-f and i-f circuits: A signal generator covering the range 450 kc to 550 kc and 1500 kc to 18,500 kc, an adjustable range audio output meter suitably matched to the receiver output impedance of 300 ohms, and a non-metallic screwdriver alignment tool.

b. I-F CIRCUIT ALIGNMENT PROCEDURE. - The i-f channel should be aligned first. Proper alignment will be secured by the following procedure:

- (1) Adjust the receiver for MCW operation.
- (2) Connect the output lead of the signal generator to the control grid of mixer tube V-102 (pin No. 4 of X-102). Connect the grounded lead to any convenient receiver chassis point.
- (3) Connect the output meter to output jack J-111 and adjust the meter for the lowest range.
- (4) Remove frequency multiplier tube V-109 from the receiver.
- (5) Adjust the signal generator for exactly 500 kc, minimum signal output, 1000 cycle modulation on.
- (6) Turn on the receiver and allow the unit to "warm up" for at least five minutes.
- (7) Advance the signal generator attenuation control until a deflection is obtained on the output meter.
- (8) Increase the signal generator output and increase the output meter range until a point is found where a further increase in signal generator signal does not cause a corresponding increase in output meter reading. Attenuate the signal generator until a drop of several db is observed in the output meter reading. This output meter reading must not be exceeded.



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during receiver alignment since it indicates a safe margin below the AVC threshold level.

(9) Adjust i-f slug numbered "1" (Z-119, V-102 Plate) on the i-f platform (see figure 5-6A) for maximum output meter readings. Repeat procedure for slugs 2-3-4-5 and 6.

## CAUTION

Care must be exercised to constantly attenuate the signal generator during alignment procedure so that the output meter reading does not rise above the level determined in step (3). Failure to do this may result in misalignment of the i-f circuits.

(10) Repeat the adjustment of i-f slugs 1-2-3-4 in the same manner as outlined to correct for any interaction between the circuits.

**c. MULTIPLIER ALIGNMENT.** - The multiplier is aligned by means of the slug adjustment of L-101 and the adjustment of C-141, C-142, and C-143. The slug adjustment for L-101 is engraved MULT. and can be located by referring to Figure 5-6B. Variable trimmer capacitors C-141, C-142 and C-143 are located on the right side of the receiver and the slotted shaft screwdriver adjustments are accessible through the holes in the shield engraved F, E and B. Refer to Figure 5-6B. To align the multiplier, proceed as follows:

(1) Connect the output lead of the signal generator to the antenna terminal of the receiver and connect the grounded lead to any convenient receiver chassis point.

(2) Connect the output meter to output jack J-104, adjust the receiver for MCW operation, turn the receiver on and allow the unit to "warm up" for at least five minutes.

(3) Loosen the Autotune locking keys and set the BAND selector control for the 12.5 to 18.5 megacycle band (band F).

(4) Rotate the TUNING control to the stop on the high frequency end of the band, then back away from the stop from two or three turns of the TUNING control.

(5) Adjust the signal generator to the frequency arrived at on the receiver. Adjust both the signal generator and the output meter to find the ave threshold level as outlined in steps (7) and (8) under i-f alignment procedure.





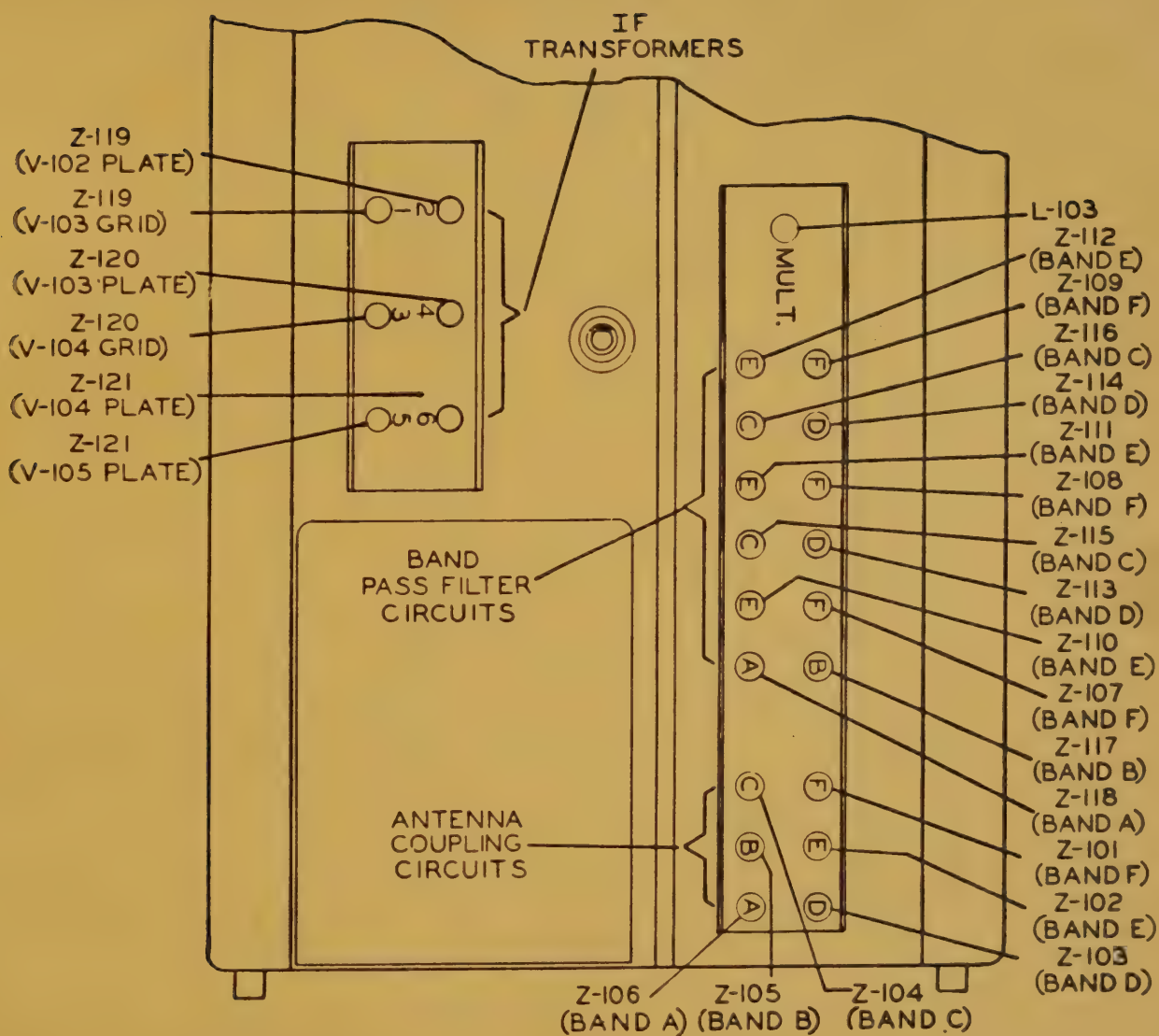


Figure 5-6A Tuned Circuit Locating Diagram





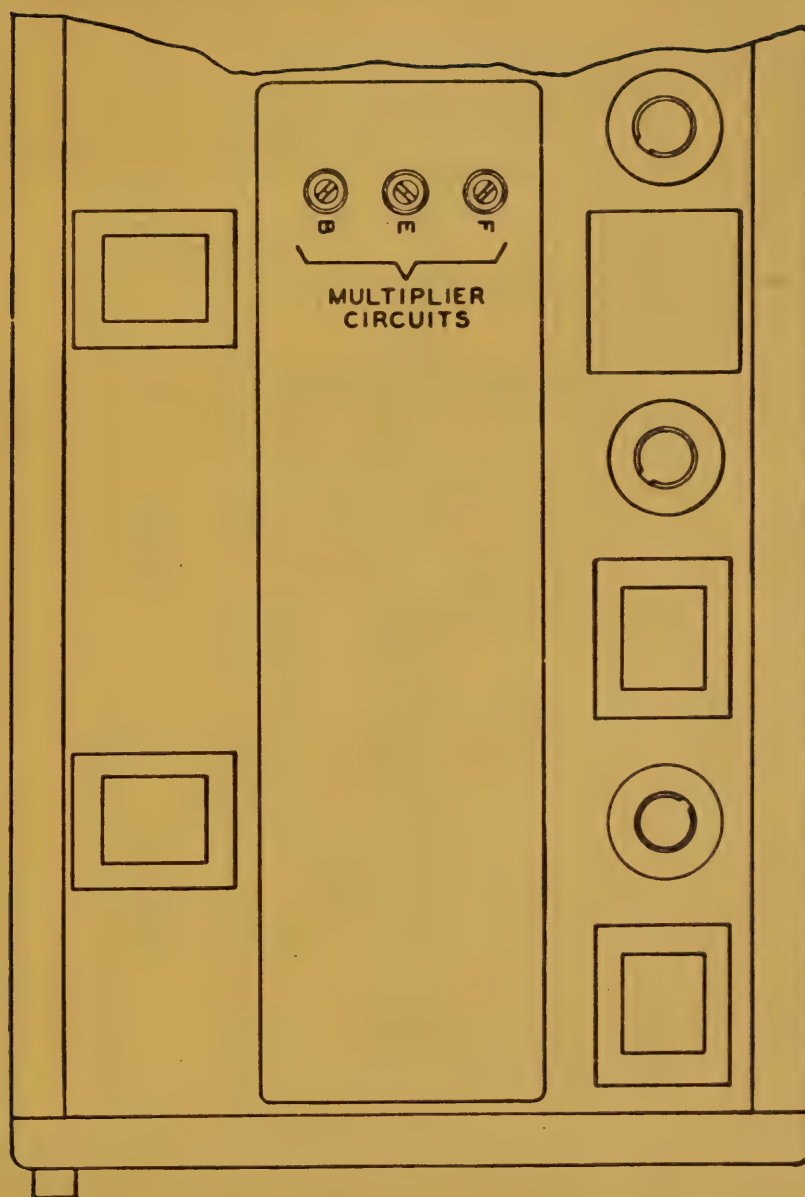


Figure 5-6B Tuned Circuit Locating Diagram



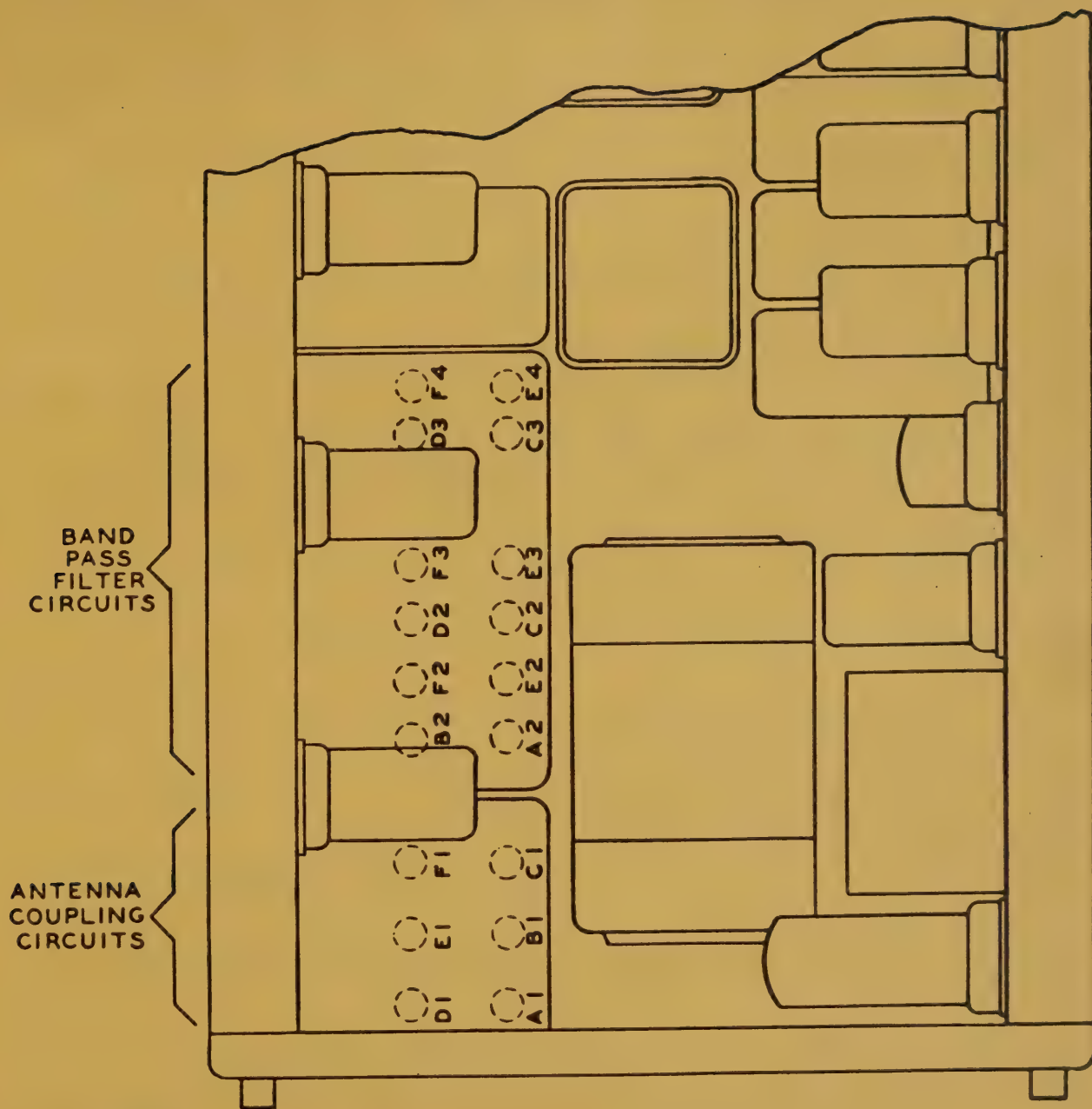


Figure 5-6C Tuned Circuit Locating Diagram





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(6) Check the MULT. slug to make sure it is near the end of travel out of the multiplier coil.

(7) Use a non-metallic alignment screwdriver to adjust trimmer capacitor C-143 through shield hole engraved F for a maximum indication on the output meter.

(8) Rotate the tuning control to the stop at the low frequency end of band F (12.5 to 18.5 megacycle). Back away from the stop two or three turns of the TUNING control.

(9) Adjust the signal generator to the frequency arrived at on the receiver.

(10) Adjust slug engraved MULT. for maximum output. Repeat steps (4) through (10) until satisfied that the oscillator multiplier circuits are "tracking" with the mixer circuits.

(11) Set the BAND selector control on band E (8.5 to 12.5 megacycle) and return the TUNING control to the high frequency end of the band as outlined in step (4).

(12) Adjust trimmer capacitor C-142 through shield hole engraved E for maximum output.

(13) Set the BAND selector control on Band B (2500-3500 kc band).

(14) Adjust trimmer capacitor C-141 through shield hole engraved B for maximum output.

d. R-F BAND PASS ALIGNMENT PROCEDURE. - To align the r-f band pass channels, proceed as follows:

(1) Rotate the TUNING control to the stop on the high frequency end of the band, then back away from the stop from two to three turns of the TUNING control.

(2) Adjust the signal generator to the frequency arrived at on the receiver. Adjust both the signal generator and the output meter to find the avc threshold level as outlined in steps (7) and (8) under i-f alignment procedure.

(3) Check the band pass and antenna coil tuning slugs of the band or bands to be aligned to make sure they are near the end of travel out of their respective coils (refer to Figure 5-6A).



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(4) Loosen the screws holding the protective covers of the alignment holes for the antenna coil and band pass coil assemblies, and slide these covers the length of the slots thus exposing the alignment holes. (Refer to Figure 5-6C.)

(5) Stamped on the cover adjacent to each hole will be found a letter and a number. The letter corresponds to the band indicated on the tuning dial and the associated slug as shown on Figure 5-6A. Use a non-metallic alignment screwdriver to adjust the trimmer capacitor corresponding to the band it is desired to adjust.

(6) Trimmer and slug adjustments are numbered consecutively beginning with the antenna coil. Adjustments for any one band should be made beginning with the highest numbered trimmer or slug adjustment and proceed to lower numbered trimmer and slug adjustments. It should be noted that the number of tuned circuits varies with the frequency bands, increasing in number as the frequency is lowered.

(7) Each trimmer should be adjusted for maximum reading on the output meter, taking care to back off the signal generator output so as not to exceed the avc threshold level determined in step (5).

(8) After the high frequency end of a given band is adjusted according to the above procedure, tuning control should be rotated to the stop at the low frequency end of the band. Back away from the stop two or three turns of the TUNING control.

(9) Find the frequency with the signal generator and adjust the correspondingly designated slug for maximum output meter reading.

(10) Repeat steps (1), (7), (8) and (9) until satisfied that the mixer and antenna circuits are "tracking" with the oscillator multiplier circuits on any given band.





**NOTES:**

1. ALL READINGS MADE TO GROUND WITH INPUT VOLTAGE OF 27 VOLTS.
2. FIRST READING MADE WITH 20 000 OHMS PER VOLT METER.  
SECOND READING MADE WITH 1000 OHMS PER VOLT METER.
3. IF ONLY ONE READING IS SHOWN, VALUES ARE IDENTICAL WITH BOTH METERS.
4. METER SCALES (LETTER SUFFIXES) ARE AS FOLLOWS: A=2.5V,  
B=10V, C=50V, D=250V.

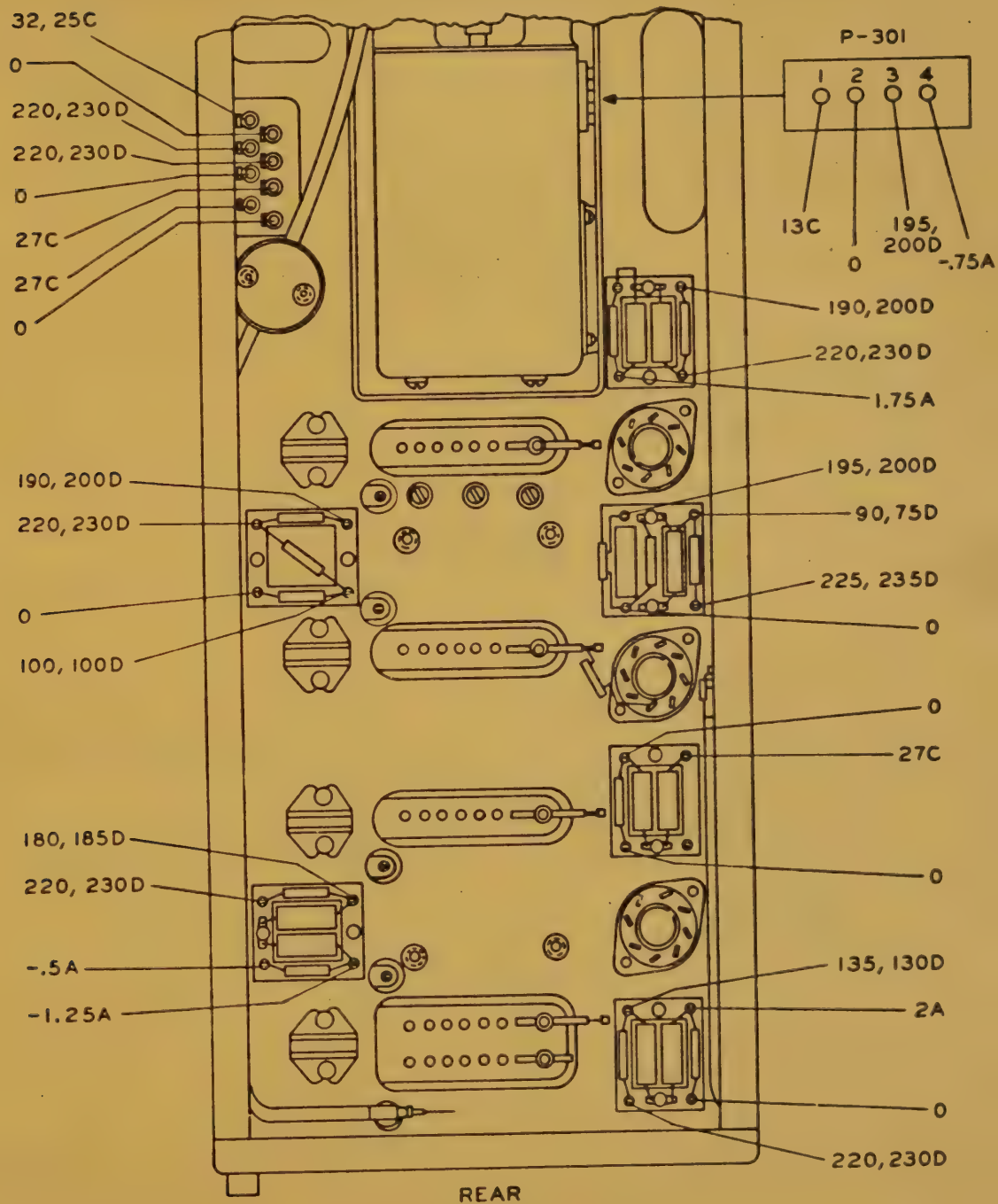


Figure 5-7 Voltage Measurements - Right Side





1. ALL READINGS MADE TO GROUND WITH INPUT VOLTAGE OF 27 VOLTS.
2. FIRST READING MADE WITH 20,000 OHMS PER VOLT METER.  
SECOND READING MADE WITH 1000 OHMS PER VOLT METER.
3. IF ONLY ONE READING IS SHOWN, VALUES ARE IDENTICAL WITH BOTH METERS.
4. METER SCALES (LETTER SUFFIXES) ARE AS FOLLOWS: A = 2.5V,  
B = 10V, C = 50V, D = 250V.





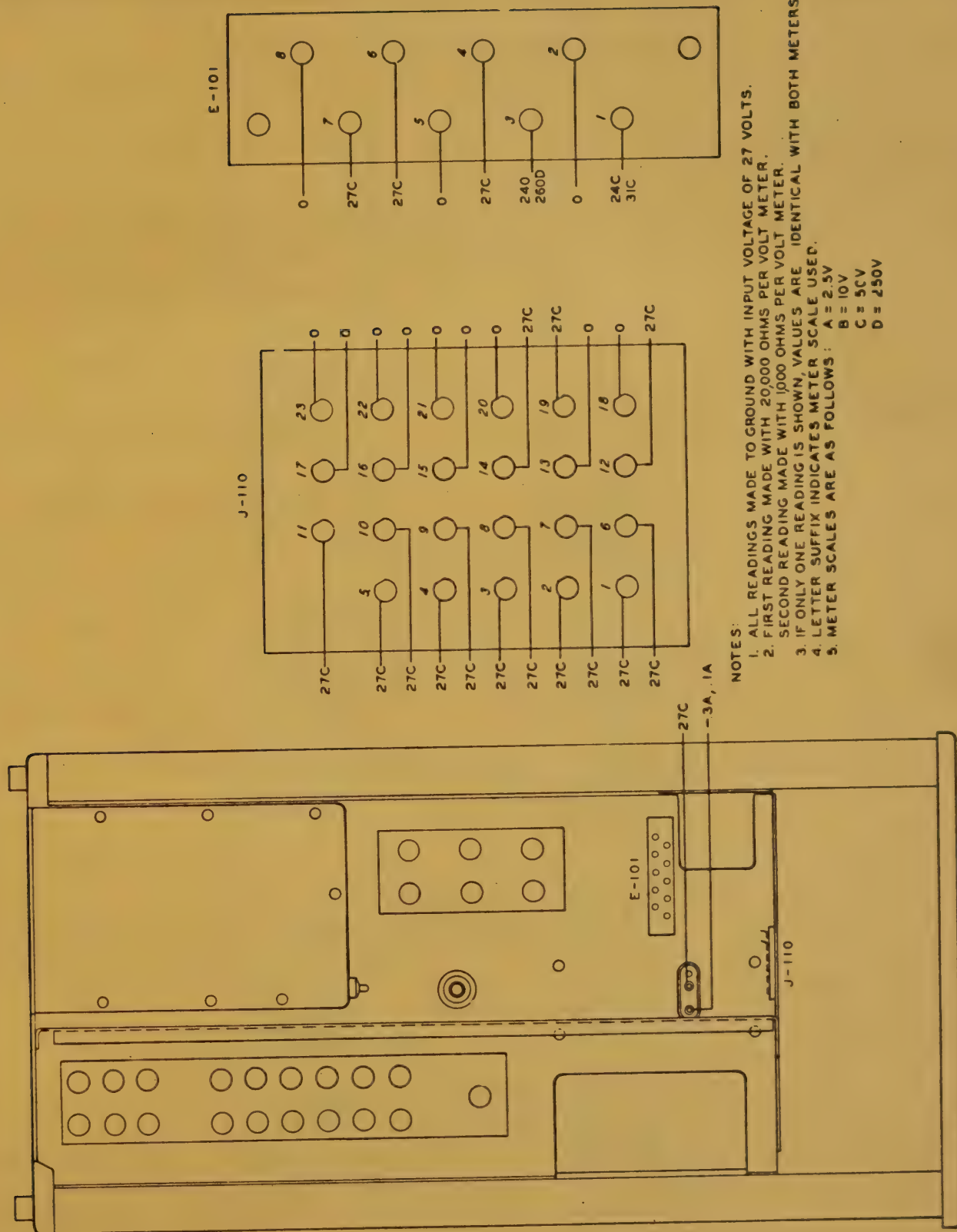


Figure 5-9 Voltage Measurements - Bottom





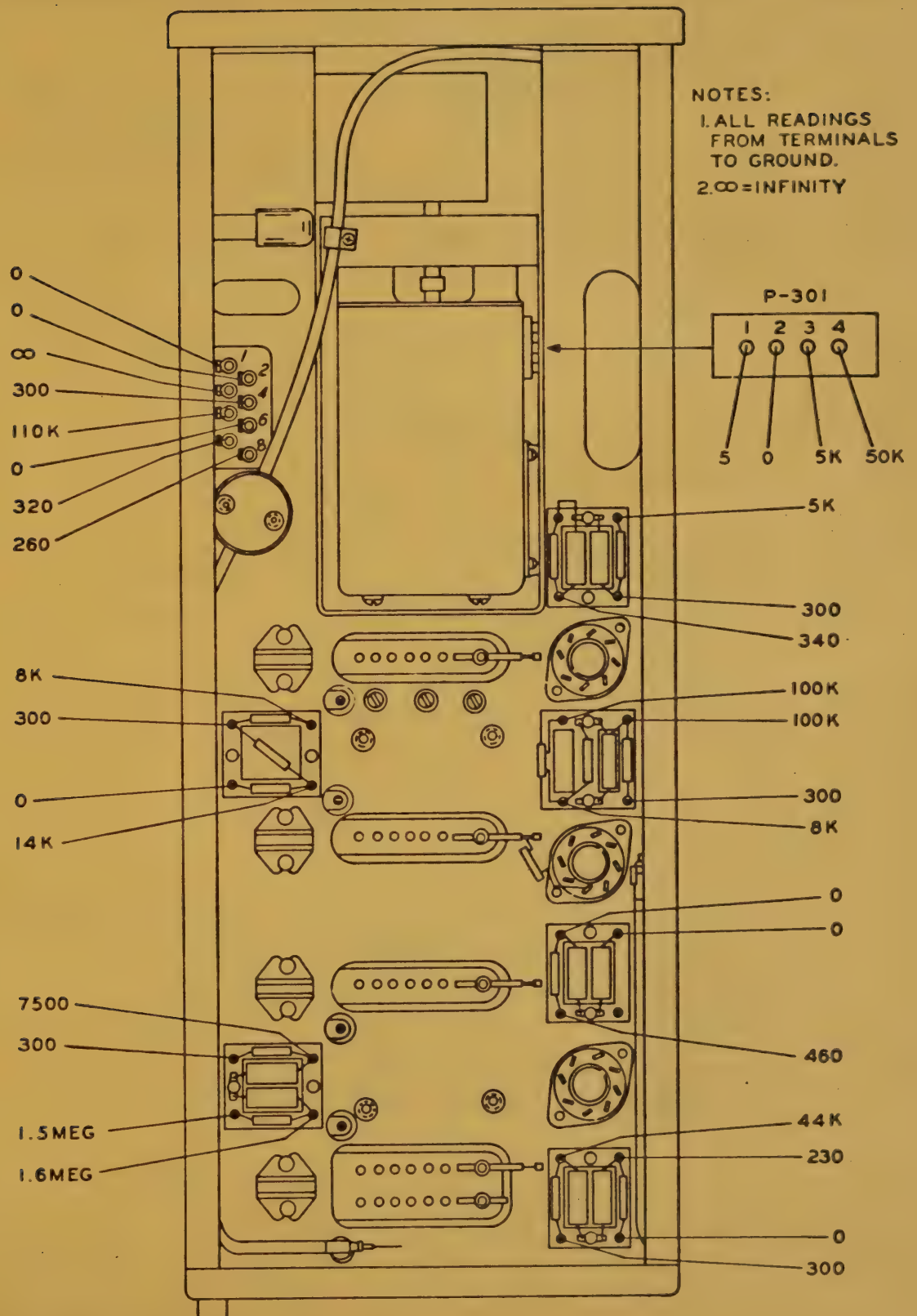


Figure 5-10 Resistance Measurements - Right Side



NOTES:  
 1. ALL READINGS  
 FROM TERMINALS  
 TO GROUND.  
 2.  $\infty$  = INFINITY

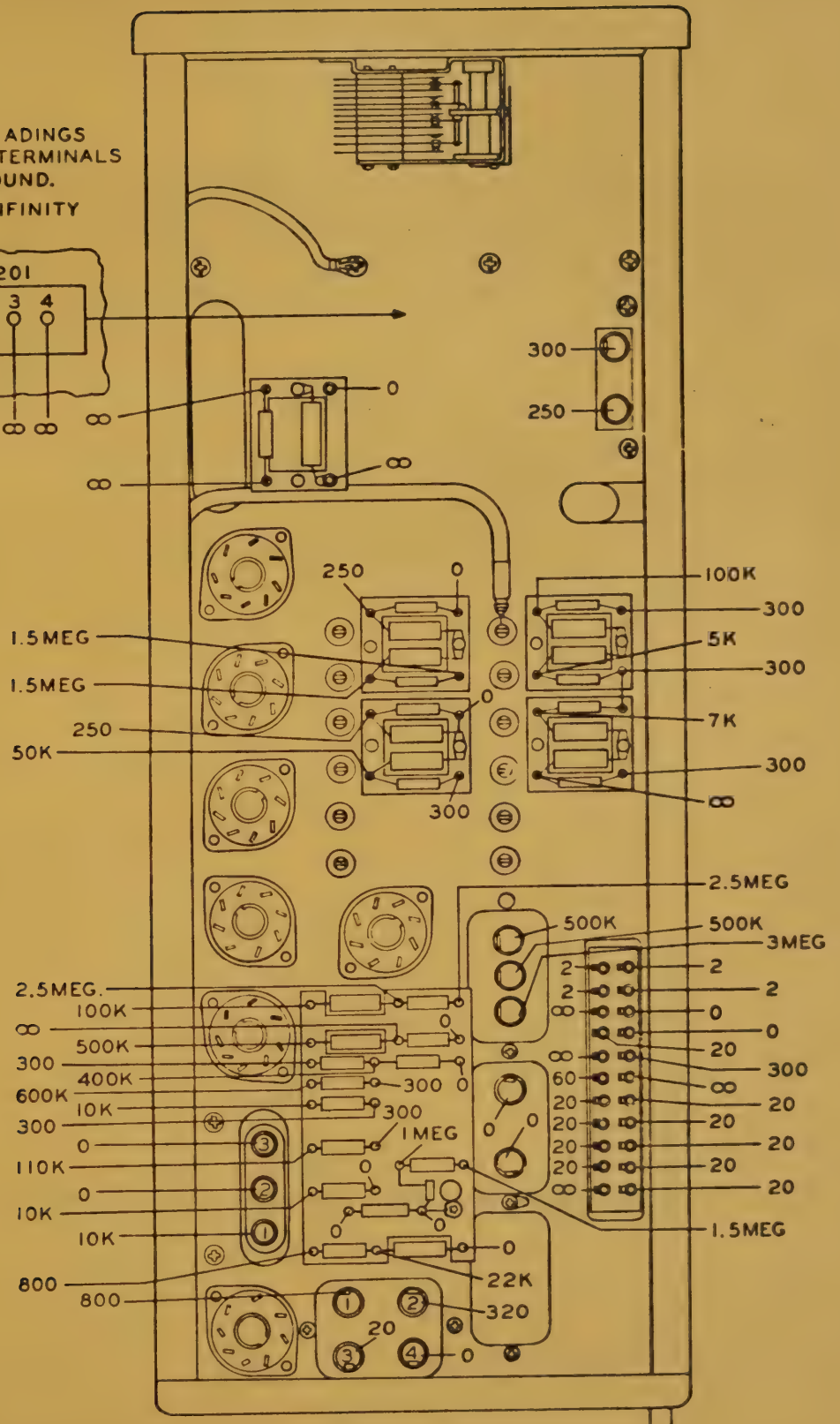
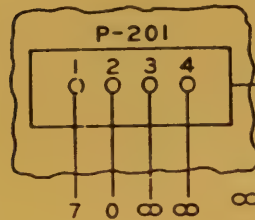
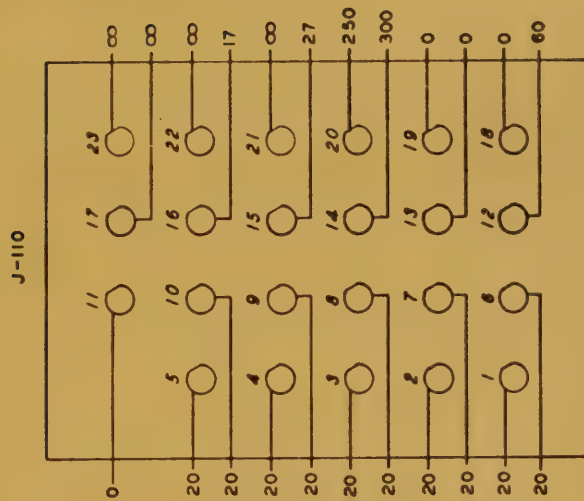
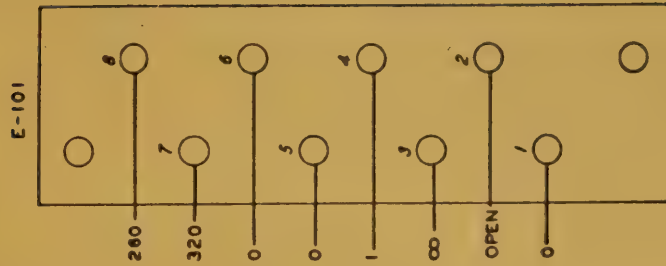
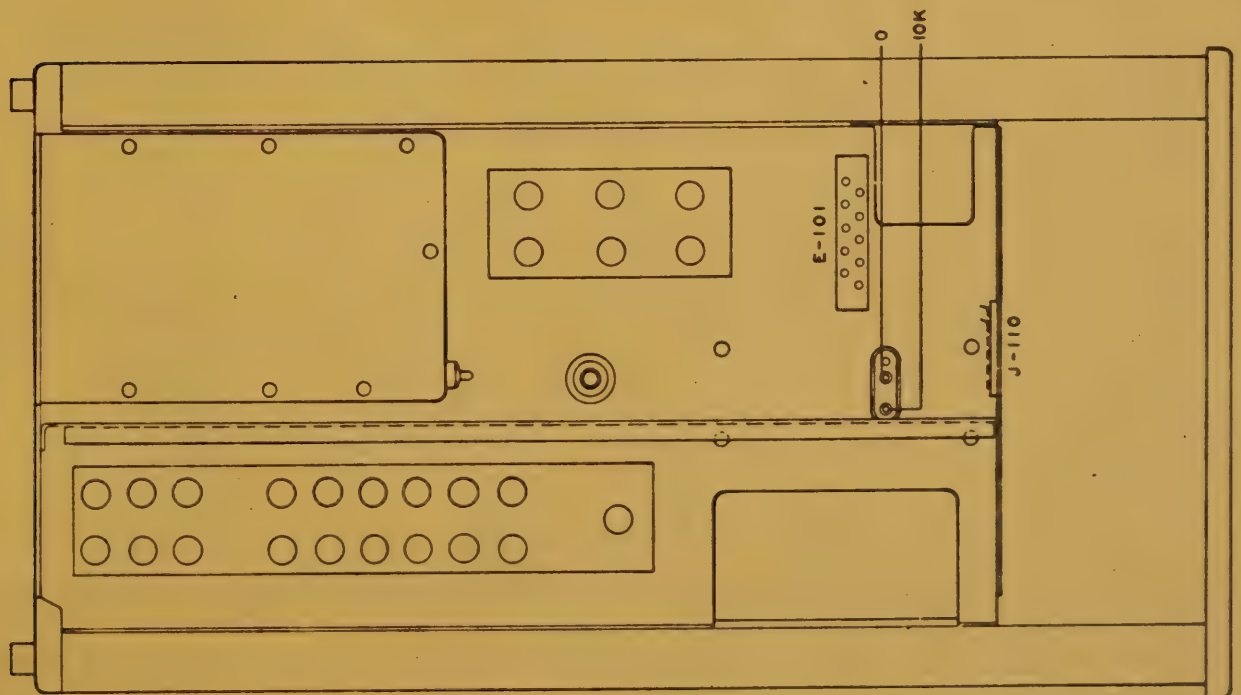


Figure 5-11 Resistance Measurements - Left Side



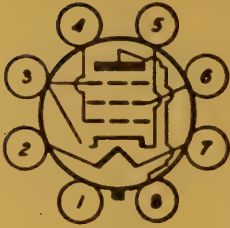

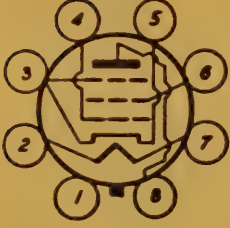
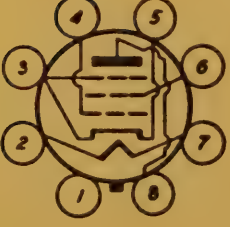


NOTES:  
 1. ALL READINGS FROM TERMINALS TO GROUND.  
 2. ∞ = INFINITY

Figure 5-12 Resistance Measurements - Bottom





		VOLTAGE TO GROUND (VOLTS)				RESISTANCE TO GROUND (OHMS)	
		TUBE PIN NUMBER	1000 OHMS PER VOLT	*SCALE	20,000 OHMS PER VOLT	*SCALE	
V-101 12SG7							
	1	0			0		0
	2	0			0		0
	3	1.55	A		1.7	A	230
	4	-.1	A		-.6	A	1.7 meg
	5	1.55	A		1.7	A	230
	6	127	D		137	D	45 K
	7	13	C		13	C	7
	8	183	D		183	D	7,500
V-102 12SG7							
	1	0			0		0
	2	27.5	C		26.5	C	1
	3	.1	A		.1	A	490
	4	-.25	A		-.7	A	500 K
	5	.1	A		.1	A	490
	6	-.05	A		-.05	A	100 K
	7	13	C		13	C	7
	8	227	D		227	D	6,000
V-103 12SG7							
	1	0			0		0
	2	13	C		13	C	8
	3	1.25	A		1.35	A	250
	4	0			0		1.6 meg
	5	1.25	A		1.35	A	250
	6	70	D		75	D	100 K
	7	27	C		26.5	C	1
	8	192	D		192	D	7,500
V-104 12SG7							
	1	0			0		0
	2	27	C		27	C	1
	3	1.8	A		2.1	A	250
	4	0			0		18
	5	1.8	A		2.1	A	250
	6	112	D		117	D	50 K
	7	13.5	C		13.5	C	7
	8	177	D		175	D	7,500

\*Meter scales are as follows:

- A = 2.5 V
- B = 10 V
- C = 50 V
- D = 250 V

Figure 5-13A Tube Socket Measurements







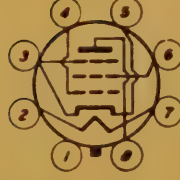
TUBE PIN NUMBER	VOLTAGE TO GROUND (VOLTS)				RESISTANCE TO GROUND (OHMS)	
	1000 OHMS PER VOLT	*SCALE	20,000 OHMS PER VOLT	*SCALE		
V-105 12SL7						
1	-0.05	A	-1.3	A	50	K
2	75	D	147	D	540	K
3	.25	A	.5	A	5	K
4	-.1	A	-.35	A	10	K
5	50	D	90	D	500	K
6	.5	A	101	A	5	K
7	13.5	C	3.5	C	7	
8	0		0		0	
V-201 12SJ7						
1	0		0		0	
2	0		0		0	
3	0		0		0	
4	-.09	A	-2.6	A	160	K
5	0		0		0	
6	110	D	115	D	Inf	
7	13.5		13.5		14	
8	230	D	230	D	Inf	
V-401 12SJ7						
1	0		0		0	
2	13.5	C	13.5	C	13.5	
3	0		0		0	
4	-.25	A	-2.25	A	110	K
5	0		0		0	
6	72.5	D	75	D	100	K
7	27	C	27	C	Inf	
8	115	D	115	D	150	K
V-402 12SJ7						
1	0		0		0	
2	0		0		0	
3	0		0		0	
4	-28	C	-30.2	C	50	K
5	0		0		0	
6	22		39	C	230	K
7	13.5	C	13.5	C	13.5	
8	5.5	B	7.6	B	5	K
V-301 12SJ7						
1	0		0		0	
2	0		0		0	
3	0		0		0	
4	-.20	A	-.45	A	165	K
5	0		0		0	
6	117	D	130	D	Inf	
7	13.5		13.5		14	
8	230	D	230	D	Inf	

\*Meter scales are as follows: A = 2.5 v  
B = 10 v  
C = 50 v  
D = 250 v

Figure 5-13B Tube Socket Measurements





	TUBE PIN NUMBER	1000 OHMS PER VOLT	VOLTAGE TO GROUND (VOLTS)	20,000 OHMS PER VOLT	RESISTANCE TO GROUND (OHMS)
			SCALE	SCALE	
V-110 12H6					
	1	0		0	0
	2	0		0	0
	3	25	D	112	2.5 meg
	4	40	D	112	Inf
	5	40	D	112	Inf
	6	NC	A	NC	27,000
	7	13.5	C	13.5	7
	8	75	D	125	500 K
V-106 12SL7					
	1	2.0	C	23.5	1 meg
	2	2.0	C	23.5	1 meg
	3	33.5	C	47.5	9,500
	4	0		0	0
	5	0		0	1 meg
	6	4	C	32	50,000
	7	13.5	C	13.5	7
	8	0		0	0
V-107 12SJ7					
	1	0		0	0
	2	13.5	C	13.5	7
	3	2.4	A	2.5	2,500
	4	0		0	500 K
	5	2.4	A	2.5	2,500
	6	65	D	70	110 K
	7	0		0	1
	8	2.4	A	2.5	110 K
V-108 12A6					
	1	0		0	0
	2	13.5	C	13.5	7
	3	210	D	205	600
	4	230	D	220	300
	5	0		0	1,300
	6	-		-	Inf
	7	27	C	27	1
	8	10	B	10	3,400
V-109 12SG7					
	1	0		0	0
	2	12.5	C	12.5	7
	3	1.5	A	1.7	320
	4	1.1	A	1.7	50 K
	5	1.5	A	1.7	320
	6	70	D	85	100 K
	7	27	C	27	1
	8	187	D	187	7,500

\*Meter scales are as follows: A= 2.5 v  
B= 10 v  
C= 50 v  
D=250 v

Figure 5-13C Tube Socket Measurements



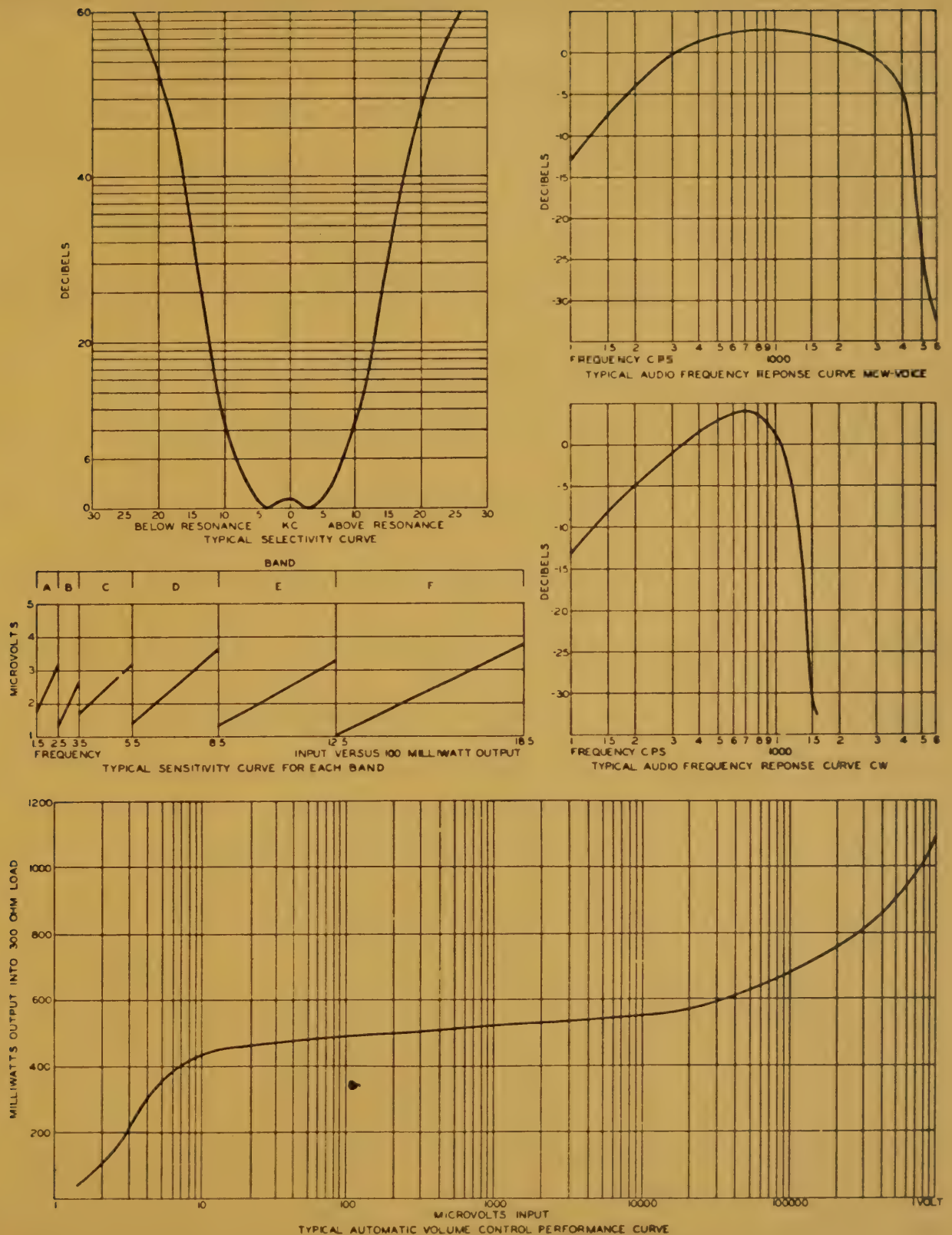


Figure 5-14 Typical Operations Curve



# SECTION VI PARTS LIST

51H-3

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
101-199 Series		Aircraft Radio Receiving Equipment	520 2544 00
B-101	AUTOTUNE motor	MOTOR: Shunt wound; 26.5 v DC; pinion gear attached to shaft	502 6914 00
C-101	RF amplifier avc bypass	CAPACITOR: 100 mmf $\pm 20\%$ ; 500 WVDC	916 4004 00
C-102	RF amplifier avc bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-103	RF amplifier cathode bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-104	RF amplifier screen bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-105, C-106	Band F band pass	CAPACITOR: 1 mmf $\pm 1/4$ mmf; 500 WV	916 4065 00
C-107, C-108	Band E band pass	CAPACITOR: 1.5 mmf $\pm 1/4$ mmf; 500 WV	916 4067 00
C-109	Band D band pass	CAPACITOR: 2 mmf $\pm 1/4$ mmf; 500 WV	916 4070 00
C-111	Band C band pass	CAPACITOR: 3 mmf $\pm 1/4$ mmf; 500 WV	916 4073 00
C-112	Mixer grid tank	CAPACITOR: 100 mmf $\pm 5\%$ ; 500 WV	916 4059 00
C-113	Band C band pass	CAPACITOR: 8 mmf $\pm 1$ mmf; 500 WV	916 4095 00
C-114	Band A band pass	CAPACITOR: 18 mmf $\pm 10\%$ ; 500 WV	916 4114 00
C-115	Mixer grid coupling	CAPACITOR: 100 mmf $\pm 10\%$ ; 500 WV	916 4003 00
C-116	Mixer cathode bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-117	Mixer plate bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-118	First i-f avc bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-119	RF and first i-f	CAPACITOR: .5 mf $\pm 40 -15\%$ ; 200 WV	961 6005 00





# SECTION VI PARTS LIST

51H-3

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
101-199 Series		Aircraft Radio Receiving Equipment	520 2544 00
B-101	AUTOTUNE motor	MOTOR: Shunt wound; 26.5 v DC; pinion gear attached to shaft	502 6914 002
C-101	RF amplifier avc bypass	CAPACITOR: 100 mmf $\pm 20\%$ ; 500 WVDC	916 4004 00
C-102	RF amplifier avc bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-103	RF amplifier cathode bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-104	RF amplifier screen bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-105, C-106	Band F band pass	CAPACITOR: 1 mmf $\pm 1/4$ mmf; 500 WV	916 4065 00
C-107, C-108	Band E band pass	CAPACITOR: 1.5 mmf $\pm 1/4$ mmf; 500 WV	916 4067 00
C-109	Band D band pass	CAPACITOR: 2 mmf $\pm 1/4$ mmf; 500 WV	916 4070 00
C-111	Band C band pass	CAPACITOR: 3 mmf $\pm 1/4$ mmf; 500 WV	916 4073 00
C-112	Mixer grid tank	CAPACITOR: 100 mmf $\pm 5\%$ ; 500 WV	916 4059 00
C-113	Band C band pass	CAPACITOR: 8 mmf $\pm 1$ mmf; 500 WV	916 4095 00
C-114	Band A band pass	CAPACITOR: 18 mmf $\pm 10\%$ ; 500 WV	916 4114 00
C-115	Mixer grid coupling	CAPACITOR: 100 mmf $\pm 10\%$ ; 500 WV	916 4003 00
C-116	Mixer cathode bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-117	Mixer plate bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-118	First i-f avc bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-119	RF and first i-f	CAPACITOR: .5 mf $\pm 40 -15\%$ ; 200 WV	961 6005 00
14300			6-1



# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-120	First i-f cathode bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-121	First i-f screen bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-122	First i-f plate bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-123	Second i-f cathode bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-124	Second i-f screen bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-125	Alignment isolating	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-126	Second i-f plate bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-127	AVC coupling	CAPACITOR: 100 mmf 500 WV	916 4003 00
C-128	BFO coupling cap	CAPACITOR: 20 mmf $\pm 20\%$ ; 500 WV	916 4119 00
C-129		CAPACITOR: Three section; .1 mf $\pm 20\%$ per section; 400 WV	961 6045 00
C-129A	AVC cathode bypass	Section of C-129	
C-129B	Balancer tube plate filter	Section of C-129	
C-129C	AVC output filter cap	Section of C-129	
C-130	Impulse coupling cap	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-131	RF bypass	CAPACITOR: 20 mmf $\pm 20\%$ ; 500 WV	916 4119 00
C-132	Accelerator tube RF coupling	CAPACITOR: 51 mmf $\pm 20\%$ ; 500 WV	916 4296 00
C-133	Noise limiter time constant cap	CAPACITOR: 470 mmf $\pm 20\%$ ; 500 WV	935 0135 00
C-134	First audio coupling	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-135	Audio output equalizing	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-136	Multiplier cathode bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-137	Multiplier screen bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-138	HF oscillator line filter	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-139	Multiplier plate bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-140	Mixer HF oscillator coupling	CAPACITOR: 100 mmf $\pm 10\%$ ; 500 WV	916 4003 00
C-141	Multiplier band A & B trimmer	CAPACITOR: 480-520 mmf; max $+10\%$ , min $-10\%$ ; 400 WV	502 6737 002
C-142	Multiplier band C & E trimmer	CAPACITOR: 95-120 mmf; max $+10\%$ , min $-10\%$ ; 400 WV	502 6738 002
C-143	Multiplier band D & F trimmer	CAPACITOR: 28-53 mmf; max $+10\%$ , min $-10\%$ ; 400 WV	502 6739 002
C-144	High voltage filter	CAPACITOR: 4 mf $+20\%$ $-10\%$ ; 600 WV	961 3001 00
C-145		CAPACITOR: Dual section; .1 mf and 1. mf $+40\%$ $-15\%$ ; 400 WV and 75 WV	930 0027 00
C-145A	High voltage filter	Section of C-145	
C-145B	Low voltage filter	Section of C-145	
C-146	Line filter	CAPACITOR: .1 mf $+40\%$ $-15\%$ ; 100 WV	930 0028 00
C-147, C-148, C-149, C-150, C-151, C-152, C-153, C-154, C-155, C-156, C-157, C-158, C-159,	Line filter	CAPACITOR: 500 mmf $\pm 20\%$ ; 500 WV	912 0008 00
14302			



# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-160, C-161, C-162, C-163, C-164, C-165, C-166, C-167, C-168	Line filter	CAPACITOR: 500 mmf $\pm 20\%$ ; 500 WV	912 0008 00
C-169	RF amplifier avc bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-170	Antenna coupling	CAPACITOR: 5 mmf $\pm 1/2$ mmf; 500 WV	916 4082 00
C-171	Antenna coupling	CAPACITOR: 8 mmf $\pm 1/2$ mmf; 500 WV	916 4094 00
C-172	Antenna coupling	CAPACITOR: 10 mmf $\pm 1$ mmf; 500 WV	916 4103 00
C-173	Antenna coupling	CAPACITOR: 20 mmf $\pm 10\%$ ; 500 WV	916 4118 00
C-174	Antenna coupling	CAPACITOR: 24 mmf $\pm 10\%$ ; 500 WV	916 4126 00
C-175	Antenna coupling	CAPACITOR: 51 mmf $\pm 10\%$ ; 500 WV	916 4295 00
C-176	Second i-f grid tank	CAPACITOR: 200 mmf $\pm 5\%$ ; 500 WV	916 5007 00
C-177	Second i-f plate tank	CAPACITOR: 200 mmf $\pm 5\%$ ; 500 WV	916 5007 00
C-178	Second i-f det. coupling	CAPACITOR: 3 mmf $\pm 1/2$ mmf; 500 WV	916 4074 00
C-179	Det. input tank	CAPACITOR: 200 mmf $\pm 5\%$ ; 500 WV	916 5007 00
C-180	First i-f plate tank	CAPACITOR: 200 mmf $\pm 5\%$ ; 500 WV	916 5007 00
C-181	First i-f, second i-f coupling	CAPACITOR: 2 mmf $\pm 1/4$ mmf; 500 WV	916 4070 00
C-182	Mixer plate tank	CAPACITOR: 68 mmf $\pm 5\%$ ; 500 WV	916 4309 00
C-183	Mixer, first i-f coupling	CAPACITOR: 2 mmf $\pm 1/4$ mmf; 500 WV	916 4070 00
C-184	First i-f grid tank	CAPACITOR: 200 mmf $\pm 5\%$ ; 500 WV	916 5007 00





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
CR-101	Crystal detector	CRYSTAL DIODE: Germanium; 0-100 mc; 50 v; 0-22.5 ma	353 0003 00
E-101	Internal wiring cable connector	BOARD TERMINAL: 8 terminal pins	502 6681 002
E-102	Internal wiring cable connector	INSULATOR: Isolantite; 1/4" diam x 5/8" lg	190 1105 00
E-103	Mounts R-110, R-111, C-118 and C-120	BOARD TERMINAL: 4 terminal pins	502 6997 002
E-104	Mounts R-115, R-116, C-123 and C-124	BOARD TERMINAL: 4 terminal pins	502 6996 002
E-105	Mounts R-107, R-108 and R-137	BOARD TERMINAL: 4 terminal pins	502 7002 002
E-106	Mounts R-102, R-103, C-103 and C-104	BOARD TERMINAL: 4 terminal pins	502 7003 002
E-107	Mounts R-105, R-106 and C-116	BOARD TERMINAL: 4 terminal pins	502 7001 002
E-108	Mounts R-114, R-136, C-137, C-140	BOARD TERMINAL: 4 terminal pins	502 7000 002
E-109	Mounts R-135, R-138, C-136, C-138	BOARD TERMINAL: 4 terminal pins	502 6999 002
E-110	Test board mounts R-135 and C-125	BOARD TERMINAL: 4 terminal pins	502 4463 002
E-111	Audio board mount R-118, R-119, R-120, R-121, R-122, R-123, R-124, R-125, R-126, R-127, R-128, R-129, R-130, R-131, R-132, R-133, C-130, C-131, C-132, C-133, C-135, C-150	BOARD TERMINAL: 31 terminal pins	502 4470 003
E-112	Mounts R-109, R-112, C-117, C-121	BOARD TERMINAL: 4 terminal pins	502 6995 002
E-113	RF band pass ter- minal board, stator contacts of S-101C and S-101D	BOARD TERMINAL: 12 band switch terminal pins and 2 contact rod supports	502 6902 002





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
E-114	Antenna terminal board and stator contacts of S-101A	BOARD TERMINAL: Ant board; 12 band switch terminal pins and 2 contact rod supports	502 6898 002
E-115	Multiplier terminal board and stator contacts of S-101E	BOARD TERMINAL: Exciter board; 6 band switch terminal pins and contact rod support	502 6729 00
E-116	Mounts R-104	BOARD TERMINAL: 2 terminal pins	502 4469 002
E-117	Mounts R-113, R-117, C-122, C-126	BOARD TERMINAL: 4 terminal pins	502 6998 002
E-118	Replacement for AUTOTUNE motor B-101	BRUSH: Carbon; positive and negative	
E-119	Replacement for AUTOTUNE motor B-101	BRUSH HOLDER CAP: Positive and negative	
E-120	Replacement for AUTOTUNE motor B-101	BRUSH HOLDER: Positive and negative	
E-121	RF tuning core	CORE: Powdered iron; 1/4" diam x 1" long; complete with adj. threaded sleeve	502 6899 002
E-122	I-F tuning core	CORE: Powdered iron; 1/4" diam x 1-3/8" long; complete with adj. threaded sleeve	502 6900 002
E-123	Internal wiring cable abrasion protector	GROMMET: 11/16" OD; 13/32" ID x 1/4" thick neoprene rubber	201 1080 00
E-124	Calibrate knob	KNOB: Round black phenolic; brass insert; fine straight knurl	502 6674 002
E-125	Gain control knob	KNOB: Round black phenolic; brass insert; fine straight knurl	502 6675 002
E-126	Band switch knob	KNOB: Round black phenolic; brass insert; fine straight knurl	502 6676 002
E-127	Tuning knob	KNOB: Round black phenolic; fine straight knurl; with handle 15/16" long	502 5938 002



# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
E-128	Channel and emission selector switch knobs	KNOB: Wing; Alcoa alloy, black anodized finish	502 4731 002
E-129	Power switch knob	KNOB: Wing; 17st Aluminum alloy, black anodized finish	502 4732 002
E-131	CFI relay unit connector	LEAD: Connector; insulated wire lead 2-3/4" long w/ banana plug terminals	502 6943 002
E-132	Dynamotor shock-mount	SHOCKMOUNT: 3/8" x 3/8" x 29/32" overall; including 8-32 NC-2 studs; max static load 4 lbs	200 0008 00
E-133	Dial light socket	SOCKET: Bracket for two bayonet base lamps	502 4616 002
H-101	Secures CFI connector	SCREW: Special; 6-32 thread with knurled head	502 6617 002
H-102	Maintenance tool	SCREWDRIVER: Special; 90° angle; Phillips No.1 point on each end	024 3000 00
H-103	Lubricates multi-turn worm	WICK: Lubricator; 9/16" x 1" x 1-1/4" max overall	502 6912 002
H-104	Lubricates single-turn worm	WICK: Lubricator; .62" x .67" x 1.0" max overall	502 6910 002
H-105	Lubricates control unit worm	WICK: Lubricator; 9/16" x 3/4" x 15/16" max overall	502 6909 002
H-106	Maintenance tool	WRENCH: Multiple spline for No. 6 Bristo set screws; hardened steel	024 9730 00
H-107	Maintenance tool	WRENCH: Multiple spline for No. 10 Bristo set screws; hardened steel	024 9710 00
H-108	Alignment tool	WRENCH: Tuning; special 60° pointed bit; 9/32" diam x 3-3/32" long max overall	502 6637 002
I-101, I-102	Provides dial illumination	LAMP: 28 v; .17 amp; clear; min bayonet base	262 3270 00
J-101	ANTENNA Connector	CONNECTOR: Single terminal push type binding post	372 1003 00
J-102	RELAY UNIT connector	CONNECTOR: 8 terminal receptacle plate	502 6687 002





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
J-103	RELAY UNIT connector	CONNECTOR: 2 terminal receptacle plate	502 6638 002
J-104	AUDIO FILTER connector	CONNECTOR: 3 terminal receptacle plate	502 6688 002
J-105	LF oscillator connector	CONNECTOR: 4 terminal receptacle plate	502 6686 002
J-106	CFI unit connector	CONNECTOR: 2 terminal receptacle plate	502 4556 002
J-107	HF oscillator connector	CONNECTOR: 4 terminal receptacle plate	502 6686 002
J-108	Dynamotor connec- tor	CONNECTOR: 3 terminal receptacle plate	502 6764 002
J-109	LINE FILTER UNIT connector	CONNECTOR: 22 terminal receptacle plate	502 4460 002
J-110	AUTOTUNE casting connector	CONNECTOR: 23 terminal receptacle plate	502 4457 002
J-112	AUTOTUNE control unit connector	CONNECTOR: 16 terminal receptacle plate	502 4554 002
K-101	Primary power control	RELAY: Single pole, normally open, double break; coil voltage 26.5 v nom	972 1009 00
K-102	Receiver disabling	RELAY: (1B) one pole normally closed; coil voltage 26.5 v nom	972 1011 00
K-103	Autotune control Relay	RELAY: Armature (Part of Autotune Control Unit C-147	502 1901 003
L-101	Mult plate tank	COIL: RF	502 6888 002
L-102	High voltage filter	COIL: Filter choke; 1.5 hy -0 +20%; .1 amp; 100 ohm dc	678 0035 00
L-103, L-104	Low voltage input filter	COIL: RF choke; 3.3 uh	240 0027 00
L-105	Control and power lead filter	COIL: RF choke; 9 uh; Aladdin #520 powdered iron core	240 0026 00
L-106, L-107, L-108, L-109, L-110,	Control and power lead filter	COIL: RF choke; 400 uh; 3 mnf dist capacity; Aladdin #520 powdered iron core	240 0023 00



# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
L-111, L-112, L-113, L-114, L-115, L-116, L-117, L-118, L-119, L-120, L-121, L-122, L-123, L-124, L-125, L-126	Control and power lead filter	COIL: RF choke; 400 uh; 3 mmf dist capacity; Aladdin #520 powdered iron core	240 0023 00
L-127	Audio output r-f filter	COIL: RF choke	502 6942 002
L-128	High voltage r-f filter	COIL: RF choke; 2.5 mh $\pm 10\%$	240 5300 00
L-129	Z-119 i-f trans- former primary	COIL: I-F primary coil; assembly of coil and two terminal boards	502 4861 003
L-130	Z-119 i-f trans- former secondary	COIL: Z-119 secondary coil; assembly of coil, C-183, C-184 and terminal boards 1-1/8" x 1-1/8" x 2-1/2" max overall	502 4860 003
L-131	Z-120 i-f trans- former primary	COIL: I-F primary coil; assembly of coil and two terminal boards	502 4861 002
L-132	Z-120 i-f trans- former secondary	COIL: Z-120 secondary coil; assembly of coil, C-176, C-181 and terminal boards	502 4859 003
L-133	Z-121 i-f trans- former primary	COIL: I-F primary coil; assembly of coil and two terminal boards	502 4861 003
L-134	Z-121 i-f trans- former secondary	COIL: Z-121 secondary coil; assembly of coil, C-178, C-179 and terminal boards	502 4858 003
O-101	Operates tuning control	AUTOTUNE MULTITURN HEAD: 96V-1 positioning mechanism; 3-1/8" x 3-1/4" x 4-5/16" overall	502 5389 004
O-119	Operates band switch	AUTOTUNE SINGLETURN HEAD: 96U-1 positioning mechanism, 1-5/8" x 2-7/8" x 4-5/8" overall	502 1977 004





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
O-138	Operates band switch pinion gears	SHAFT: Band switch; flexible shafting with attached sleeves; 3/16" diam x 15-1/4" long, overall	502 6692 002
O-147	AUTOTUNE system control	CONTROL UNIT: Consists of electrical control circuit components; 1-5/8" x 1-5/8" x 2-5/32" max overall	502 5388 004
P-101	Receiver power connector	CONNECTOR: 24 terminal plug	502 7006 002
P-102	Line filter unit connector	CONNECTOR: 22 terminal plug pins	502 6765 002
P-103	AUTOTUNE casting connector	CONNECTOR: 23 terminal plug board	502 6906 002
P-104	AUTOTUNE control unit connector	CONNECTOR: 16 terminal plug board	502 6433 002
R-101	RF amplifier avc feed	RESISTOR: 100,000 ohm $\pm 20\%$ ; 1/2 w	745 1171 00
R-102	RF amplifier cathode	RESISTOR: 220 ohm $\pm 10\%$ ; 1/2 w	745 1058 00
R-103	RF amplifier screen	RESISTOR: 47,000 ohms $\pm 10\%$ ; 1/2 w	745 1156 00
R-104	RF amplifier plate	RESISTOR: 4700 ohms $\pm 20\%$ ; 1/2 w	745 1115 00
R-105	Mixer grid	RESISTOR: 47,000 ohms $\pm 10\%$ ; 1/2 w	745 1198 00
R-106	Mixer cathode	RESISTOR: 470 ohm $\pm 10\%$ ; 1/2 w	745 1072 00
R-107, R-108	Mixer and i-f HV bleeder	RESISTOR: 22,000 ohm $\pm 20\%$ ; 1 w	745 3143 00
R-109	Mixer plate	RESISTOR: 4700 ohm $\pm 20\%$ ; 1/2 w	745 1115 00
R-110	First i-f amplifier avc	RESISTOR: 47,000 ohm $\pm 20\%$ ; 1/2 w	745 1157 00
R-111	First i-f amplifier cathode	RESISTOR: 220 ohm $\pm 5\%$ ; 1/2 w	745 1057 00
R-112	First i-f amplifier screen	RESISTOR: 100,000 ohm $\pm 20\%$ ; 1/2 w	745 1171 00





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R-113	First i-f amplifier plate	RESISTOR: 4700 ohm $\pm 20\%$ ; 1/2 w	745 1115 00
R-114	Mixer injection grid	RESISTOR: 100,000 ohm $\pm 20\%$ ; 1/2 w	745 1171 00
R-115	Second i-f ampli- fier cathode	RESISTOR: 220 ohm $\pm 5\%$ ; 1/2 w	745 1057 00
R-116	Second i-f ampli- fier screen	RESISTOR: 100,000 ohm $\pm 20\%$ ; 1/2 w	745 1171 00
R-117	Second i-f ampli- fier plate	RESISTOR: 4700 ohm $\pm 20\%$ ; 1/2 w	745 1115 00
R-118	Detector load	RESISTOR: 47,000 ohms $\pm 10\%$ ; 1/2 w	745 1156 00
R-119	Detector load	RESISTOR: 47,000 ohms $\pm 10\%$ ; 1/2 w	745 1156 00
R-120	Detector load	RESISTOR: 10,000 ohm $\pm 10\%$ ; 1/2 w	745 1128 00
R-121	AVC load	RESISTOR: 1.0 megohms $\pm 20\%$ ; 1/2 w	745 1213 00
R-122	Delay voltage divider	RESISTOR: 10,000 ohms $\pm 10\%$ ; 1/2 w	745 1128 00
R-123	AVC accelerator tube plate load	RESISTOR: 0.47 megohms $\pm 20\%$ ; 1/2 w	745 1199 00
R-124	Balancer tube plate resistor	RESISTOR: 0.47 megohms $\pm 5\%$ ; 1/2 w	745 1197 00
R-125	Time constant resistor	RESISTOR: 0.47 megohms $\pm 20\%$ ; 1/2 w	745 1199 00
R-126	AVC accelerator tube plate load	RESISTOR: 0.47 megohms $\pm 20\%$ ; 1/2 w	745 1199 00
R-127	Audio driver plate load	RESISTOR: 100,000 ohm $\pm 20\%$ ; 1/2 w	745 1171 00
R-128	Impulse coupling resistor	RESISTOR: 220,000 ohm $\pm 20\%$ ; 1/2 w	745 1185 00
R-129	Limiter time constant resistor	RESISTOR: 1.3 megohms $\pm 5\%$ ; 1/2 w	745 1217 00
R-130	Balancer tube plate resistor	RESISTOR: 0.47 megohms $\pm 5\%$ ; 1/2 w	745 1197 00



# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R-131	LFO decoupling	RESISTOR: 3300 ohm $\pm 20\%$ ; 1/2 w	745 1108 00
R-132	Delay voltage dropping resistor	RESISTOR: 0.10 megohms $\pm 10\%$ ; 1 w	745 3170 00
R-133	Delay voltage divider	RESISTOR: 22,000 ohms $\pm 20\%$ ; 1/2 w	745 1143 00
R-134	Audio output equalization	RESISTOR: 22,000 ohm $\pm 20\%$ ; 1/2 w	745 1143 00
R-135	Multiplier cathode	RESISTOR: 330 ohm $\pm 10\%$ ; 1/2 w	745 1065 00
R-136	Multiplier screen	RESISTOR: 100,000 ohm $\pm 20\%$ ; 1/2 w	745 1171 00
R-137	Multiplier plate	RESISTOR: 47,000 ohm $\pm 20\%$ ; 1/2 w	745 1157 00
R-138	HFO decoupling	RESISTOR: 4700 ohm $\pm 20\%$ ; 1/2 w	745 1115 00
R-139	"T" pad and cathode control	ATTENUATOR: Variable; composition; 3 section; 1/2 w per section	380 000 <sup>8</sup> 00
R-140	"T" pad	RESISTOR: 8 ohm $\pm 5\%$ ; 16 w	747 1066 00
R-141			
R-142	Series filament	RESISTOR: 85 ohm $\pm 5\%$ ; 10 w	747 9000 00
R-143	Alignment isolating	RESISTOR: 3300 ohm $\pm 20\%$ ; 1/2 w	745 1108 00
R-144	Sensitivity control	RESISTOR: Variable; 500 ohm; linear taper	380 0007 00
R-145	Multiplier band A & B equalizer	RESISTOR: 10,000 ohm $\pm 10\%$ ; 1/2 w	745 1128 00
R-146	Multiplier band C & E equalizer	RESISTOR: 10 ohm $\pm 10\%$ ; 1/2 w	745 1002 00
R-147	Multiplier band D & F equalizer	RESISTOR: 15 ohm $\pm 10\%$ ; 1/2 w	745 1009 00
R-150	Balancer tube cathode resistor	RESISTOR: 4700 ohm $\pm 5\%$ ; 1/2 w	745 1113 00
R-151	Audio driver grid	RESISTOR: 470,000 ohm $\pm 20\%$ ; 1/2 w	745 1199 00
R-152	Audio driver cathode	RESISTOR: 2000 ohms $\pm 5\%$ ; 1/2 w	745 1099 00





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R-153	Audio output cathode	RESISTOR: 330 ohm $\pm 5\%$ ; 1 w	745 3064 00
R-154	Balancer tube cathode resistor	RESISTOR: 4700 ohm $\pm 5\%$ ; 1/2 w	745 1113 00
R-155	Detector load	RESISTOR: 0.15 megohms $\pm 10\%$ ; 1/2 w	745 1177 00
R-156	Static drain	RESISTOR: 47,000 ohms $\pm 10\%$ ; 1/2 w	745 1198 00
S-101		SWITCH: Consists of switch assemblies S-101A through S-101E	
S-101A	ANTENNA coupling band switch	SWITCH: Rack gear and movable contact assembly; laminated phenolic rack; silver plated phosphor-bronze contacts	502 6904 00
S-101B	RF amplifier grid band switch	SWITCH: Rack gear and movable contact assembly; laminated phenolic rack; silver plated phosphor-bronze contacts; Part of S-101A	
S-101C	RF amplifier plate band switch	SWITCH: Rack gear and movable contact assembly; laminated phenolic rack; silver plated phosphor-bronze contact	502 6708 00
S-101D	Mixer grid, band switch	SWITCH: Rack gear and movable contact assembly; laminated phenolic rack; silver plated phosphor-bronze contact	502 6708 00
S-101E	Multiplier, band switch	SWITCH: Rack gear and movable contact assembly; laminated phenolic rack; silver plated phosphor-bronze contact	502 6708 00
S-102	CW, MCW-CAL switch	SWITCH: 3 circuit, 3 position	502 4686 00
S-103	Calibrate switch	SWITCH: One normally open, one normally closed circuit	260 0012 00
S-104	Power control	SWITCH: Control; manual operate; remote or manual release; 26.5 v Solenoid	269 0012 00
S-105	Channel selector	SWITCH: 1 circuit, 10 pos; non-shortening rotary	259 0012 00
S-106	Channel seeking (ccarse)	SWITCH: 1 circuit, 10 position; shorting type	502 1894 003
S-107	Channel seeking (fine)	SWITCH: 1 circuit normally closed; cam operated	502 6428 002
S-108	AUTOTUNE over run limit switch	SWITCH: 1 circuit normally closed	502 6413 002



# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
S-109	Motor reversing switch movable contacts	SWITCH: 3 circuits, 2 position, arm assembly	502 6435 002
	Motor reversing switch stationary contacts	SWITCH: 3 circuit, 2 position, contact mtg strip assembly	502 6438 002
S-110	Pilot lamp circuit control	SWITCH: Toggle SPST	266 3006 00
T-101	Audio output transformer	TRANSFORMER: Pri: 7000 ohms impedance; Sec: 300 ohms impedance; 1 watt max freq response 300 to 4000 cps $\pm 2$ db	677 0037 00
V-101	RF amplifier	TUBE: 12SG7; HF amplifier pentode	254 0251 00
V-102	Mixer	TUBE: 12SG7; HF amplifier pentode	254 0251 00
V-103	First i-f amplifier	TUBE: 12SG7; HF amplifier pentode	254 0251 00
V-104	Second i-f amplifier	TUBE: 12SG7; HF amplifier pentode	254 0251 00
V-105	Balancer tube	TUBE: 12SL7; Twin triode amplifier	254 0258 00
V-106	AVC tube	TUBE: 12SL7; Twin triode amplifier	254 0258 00
V-107	Audio driver	TUBE: 12SJ7; Triple grid det amplifier	254 0254 00
V-108	Audio output	TUBE: 12A6; Beam power amplifier	254 0236 00
V-109	HF osc multiplier	TUBE: 12SG7; HF amplifier pentode	254 0251 00
V-110	Noise limiter tube	TUBE: 12H6; Duo-diode	254 0240 00
X-101, X-102, X-103, X-104, X-105, X-106, X-107, X-108, X-109, X-110	Socket for V-101, V-102, V-103, V-104, V-106, V-107, V-108, V-109, V-110	SOCKET: Tube; std octal; ceramic	220 1012 00
Z-101	Band F, 12.5 mc - 18.5 mc, r-f tuning	COIL: RF; 12.5 - 18.5 mc	502 6961 003





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
Z-102	Band E, 8.5 mc - 12.5 mc, r-f tuning	COIL: RF; 8.5 - 12.5 mc	502 6960 003
Z-103	Band D, 5.5 mc - 8.5 mc, r-f tuning	COIL: RF; 5.5 - 8.5 mc	502 6962 003
Z-104	Band C, 3.5 mc - 5.5 mc, r-f tuning	COIL: RF; 3.5 - 5.5 mc	502 6963 003
Z-105	Band B, 2.5 mc - 3.5 mc, r-f tuning	COIL: RF; 2.5 - 3.5 mc	502 6964 003
Z-106	Band A, 1.5 mc - 2.5 mc, r-f tuning	COIL: RF; 1.5 - 2.5 mc	502 6965 003
Z-107, Z-108, Z-109	Band F, 12.5 - 18.5 mc, band pass tuning	COIL: RF; 8.5 - 12 .5 mc	502 6960 003
Z-110, Z-111, Z-112	Band E, 8.5 - 12.5 mc, band pass tuning	COIL: RF; 12.5 - 18.5 mc	502 6961 00
Z-113, Z-114	Band D, 5.5 - 8.5 mc, band pass tuning	COIL: RF; 5.5 - 8.5 mc	502 6962 003
Z-115, Z-116	Band C, 3.5 - 5.5 mc, band pass tuning	COIL: RF; 3.5 - 5.5 mc	502 6963 003
Z-117	Band B, 2.5 - 3.5 mc, band pass tuning	COIL: RF; 2.5 - 3.5 mc	502 6964 003
Z-118	Band A, 1.5 - 2.5 mc, band pass tuning	COIL: RF; 1.5 - 2.5 mc	502 6965 003
Z-119	First i-f trans- former	TRANSFORMER: I-F; 450 -550 kc	502 7034 004
Z-120	Second i-f trans- former	TRANSFORMER: I-F; 450-550 kc	502 7035 004





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
Z-121	Third i-f transformer	TRANSFORMER: I-F; 450-550 kc	502 7036 004
Z-122	Audio filter	FILTER: AF band pass or low pass; band pass characteristics 300-400 cps; less than 1.5 db below 1000 cps response; 1600 cps and above 30 db or more below 1000 cps response	673 0036 00
Z-123	Antenna coil assembly	COIL ASSEMBLY: Consists of Z-101, Z-102, Z-103, Z-104, Z-105, Z-106, C-101, C-170, C-171, C-172, C-173, C-174, C-175 and E-113	502 4615 004
Z-124	Bandpass coil assembly	COIL ASSEMBLY: Consists of Z-107, Z-108, Z-109, Z-110, Z-111, Z-112, Z-113, Z-114, Z-115, Z-116, Z-117, Z-118, C-105, C-106, C-107, C-108, C-109, C-111, C-113, C-114, and E-112	502 4614 004
Z-125	Multiplier coil assembly	COIL ASSEMBLY: Consists of L-101, C-139, C-141, C-142, C-143 and E-114	502 6843 003
Z-126	Power and control lead filter	FILTER ASSEMBLY: Line: Consists of box and cover assembly; C-146, C-147, C-148, C-149, C-150, C-151, C-152, C-153, C-154, C-155, C-156, C-157, C-158, C-159, C-160, C-161, C-162, C-163, C-164, C-165, C-166, C-167, L-103, L-104, L-105, L-106, L-107, L-108, L-109, L-110, L-111, L-112, L-113, L-114, L-115, L-116, L-117, L-118, L-119, L-120, L-121, L-122, L-123, L-124, L-125, L-126, J-108, K-101 and P-101	502 4607 004
201-299 Series		LF OSCILLATOR: Oscillator circuit components in a sealed enclosure	502 0879 003
NOTE: This unit is dehydrated and hermetically sealed. It should be returned to Collins Radio Company if servicing is needed.			
301-399 Series		HF OSCILLATOR: Oscillator circuit components in a sealed enclosure	502 0962 003
NOTE: This unit is dehydrated and hermetically sealed. It should be returned to Collins Radio Company if servicing is needed.			
401-499 Series		CFI ASSEMBLY:	520 3496 00



# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-401	CFI Oscillator Trimmer	CAPACITOR: 270 mmf $\pm 5\%$ ; 500 WV	916 5012 00
C-402	CFI Oscillator screen bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-403	CFI Oscillator plate bypass	CAPACITOR: 3900 mmf $\pm 5\%$ ; 500 WV	935 2099 00
C-404	CFI Oscillator filament bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-405	CFI Oscillator plate filter	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-406	CFI Multiplier screen bypass	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-407	CFI output plate coupling	CAPACITOR: 5 mmf $\pm 1/2$ mmf; 500 WV	916 4083 00
C-408	CFI Oscillator multiplier coup- ling	CAPACITOR: 500 mmf $\pm 20\%$ ; 500 WV	912 0282 00
C-409	CFI Oscillator feedback	CAPACITOR: .01 mf $\pm 20\%$ ; 300 WV	935 2118 00
C-410	CFI Oscillator plate tank	CAPACITOR: 500 mmf $\pm 20\%$ ; 500 WV	912 0282 00
E-401	CFI resistor board mounts C-403, C-407, C-409, L-402, R-403, R-404, R-405, R-406, and R-407	BOARD, TERMINAL: 22 terminal pins	502 4604 003
L-402	CFI Multiplier plate choke	COIL: RF Choke; 1.3 uh $\pm 10\%$ ; Aladdin #520 powdered iron core	240 0024 00
L-403	CFI Oscillator plate tank	COIL: 3.5 uh $\pm 10\%$ ; Aladdin powdered iron core #520	278 0012 00
R-401	CFI Oscillator grid	RESISTOR: 100,000 ohm $\pm 20\%$ ; 1/2 w	745 1171 00
R-402	CFI Multiplier grid	RESISTOR: 47,000 ohm $\pm 20\%$ ; 1/2 w	745 1157 00





# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R-403	CFI Oscillator plate	RESISTOR: 33,000 ohm $\pm 20\%$ ; 1/2 w	745 1150 00
R-404	CFI Multiplier screen	RESISTOR: 220,000 ohm $\pm 20\%$ ; 1/2 w	745 1185 00
R-405	CFI Multiplier plate voltage divider	RESISTOR: 100,000 ohm $\pm 20\%$ ; 1 w	745 3171 00
R-406	CFI Multiplier plate voltage divider	RESISTOR: 4700 ohm $\pm 20\%$ ; 1/2 w	745 1115 00
R-407	CFI Oscillator screen	RESISTOR: 47,000 ohm $\pm 20\%$ ; 1/2 w	745 1157 00
V-401	CFI Oscillator	TUBE: 12SJ7; triple grid det amplifier	254 0254 00
V-402	CFI Amplifier	TUBE: 12SJ7; triple grid det amplifier	254 0254 00
X-401 X-402	Socket for V-101, V-102	SOCKET: Tube; std octal; low loss mica filled bakelite	220 1005 00
Y-401	CFI Frequency control	CRYSTAL: 200 kc; metal holder; 1.32" diam x 2.56" long; w/ small wafer octal base; crystal electrodes connected to pins 3 and 7	291 0003 00
501-599 Series		RELAY UNIT ASSEMBLY:	502 6798 002
C-501	Calibration input	CAPACITOR: 36 mmf $\pm 20\%$ ; 500 WV	916 4009 00
K-501	MCW, CW, Cali- brate control	RELAY: (1A, 2B) three pole; one normally open and two normally closed; coil voltage 26.5 v nom	972 1010 00
K-502	Calibrate, Re- ceive control	RELAY: (4C) four pole double throw; coil vol- tage 26.5 v nom	972 1008 00
P-502	Relay unit con- nector	CONNECTOR: 10 staked terminal plug pins	502 6790 002
601-699 Series		DYNAMOTOR ASSEMBLY: HV dynamotor	502 6889 002
C-601	HV filter	CAPACITOR: 8200 mmf $\pm 10\%$ ; 300 WV	935 2114 00



# PARTS LIST

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-602	Input filter	CAPACITOR: 8200 mmf $\pm 10\%$ ; 300 WV	935 2114 00
D-601	Receiver hv supply	DYNAMOTOR: Input 26.5 v; output 220 v at .1 amp	231 0027 00
E-601	Replacement for 231 0027 00 dynamotor	BRUSH: Carbon; positive hv brush; com- plete with pigtail lead and spring	234 0133 00
E-602	Replacement for 231 0027 00 dynamotor	BRUSH: Carbon; negative hv brush; com- plete with pigtail lead and spring	234 0132 00
E-603	Replacement for 231 0027 00 dynamotor	BRUSH: Carbon; positive input; complete with pigtail lead and spring	234 0134 00
E-604	Replacement for 231 0027 00 dynamotor	BRUSH: Carbon; negative input; complete with pigtail lead and spring	234 0137 00
E-605 E-606 E-607 E-608	Replacement for 231 0027 00 dynamotor	CAP, BRUSH HOLDER: Molded bakelite; brass insert threaded 3/8-32	234 0136 00
E-609 E-610	Replacement for 231 0027 00 dynamotor	HOLDER, BRUSH: Low voltage; solder lug connector	234 0138 00
E-611	Replacement for 231 0027 00 dynamotor	HOLDER, BRUSH: +hv; solder lug connector	234 0139 00
E-612	Replacement for 231 0027 00 dynamotor	HOLDER, BRUSH: -hv; solder lug connector	234 0140 00
P-601	Dynamotor connector	CONNECTOR: 3 terminal plug board	502 6784 00
900-999 Series	Shock-reducing mounting rack	SHOCKMOUNT: 4" x 10-1/2" x 23-27/32" max overall	502 4365 005
J-901	Power and control connector	CONNECTOR: Female; 24 terminals	502 4349 003



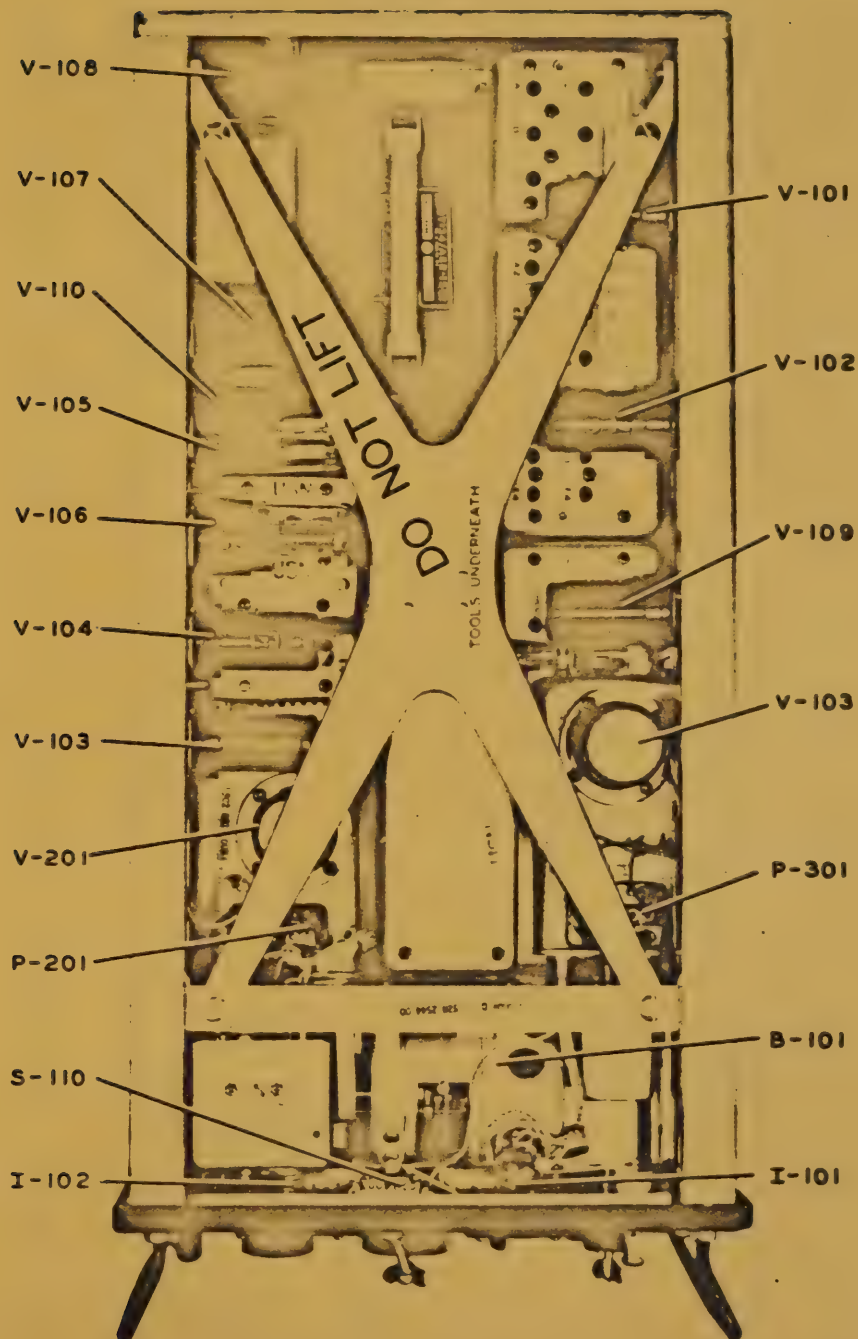


Figure 7-1 Receiver Top





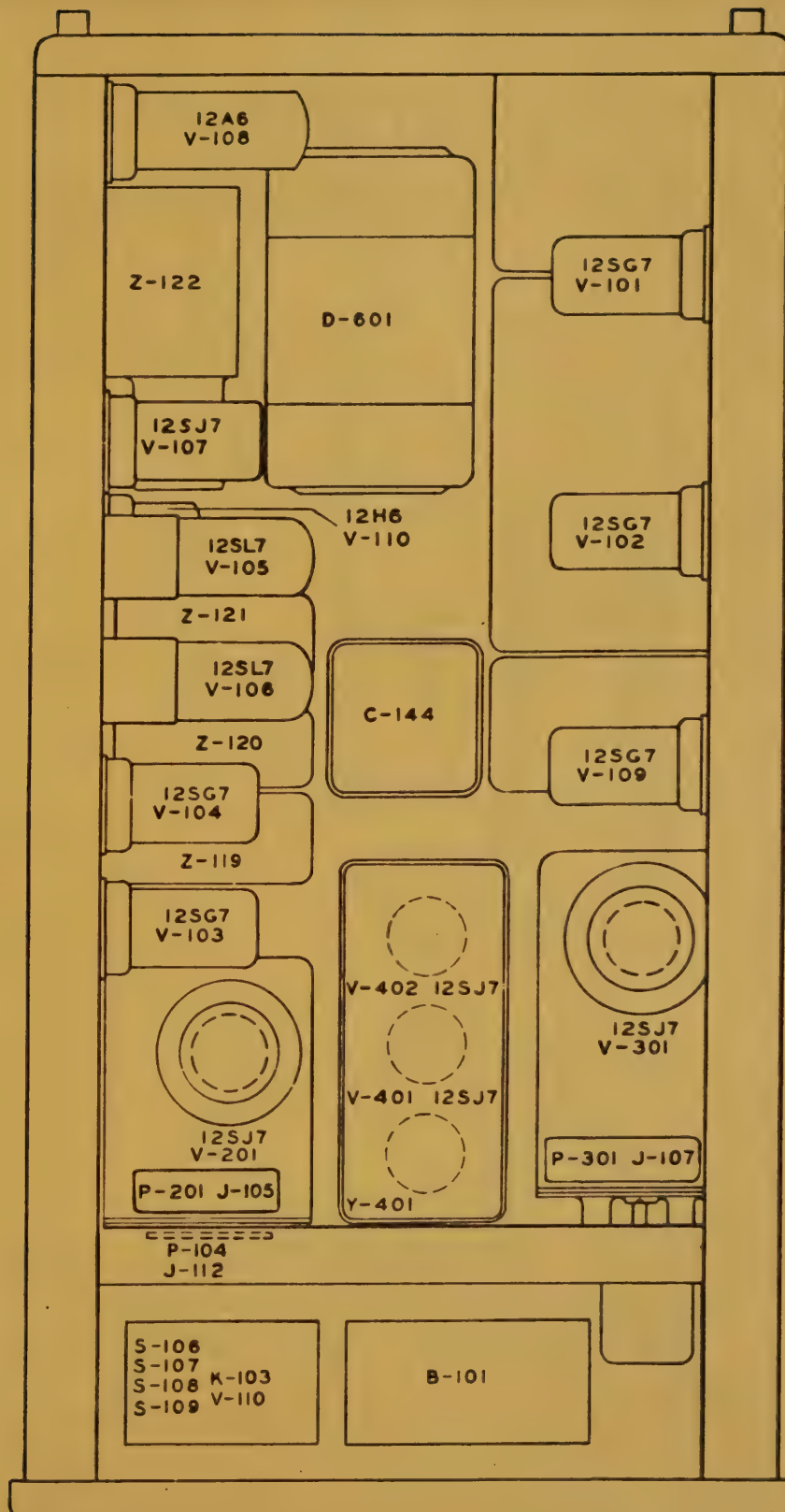


Figure 7-2 Receiver Parts Arrangement - Top



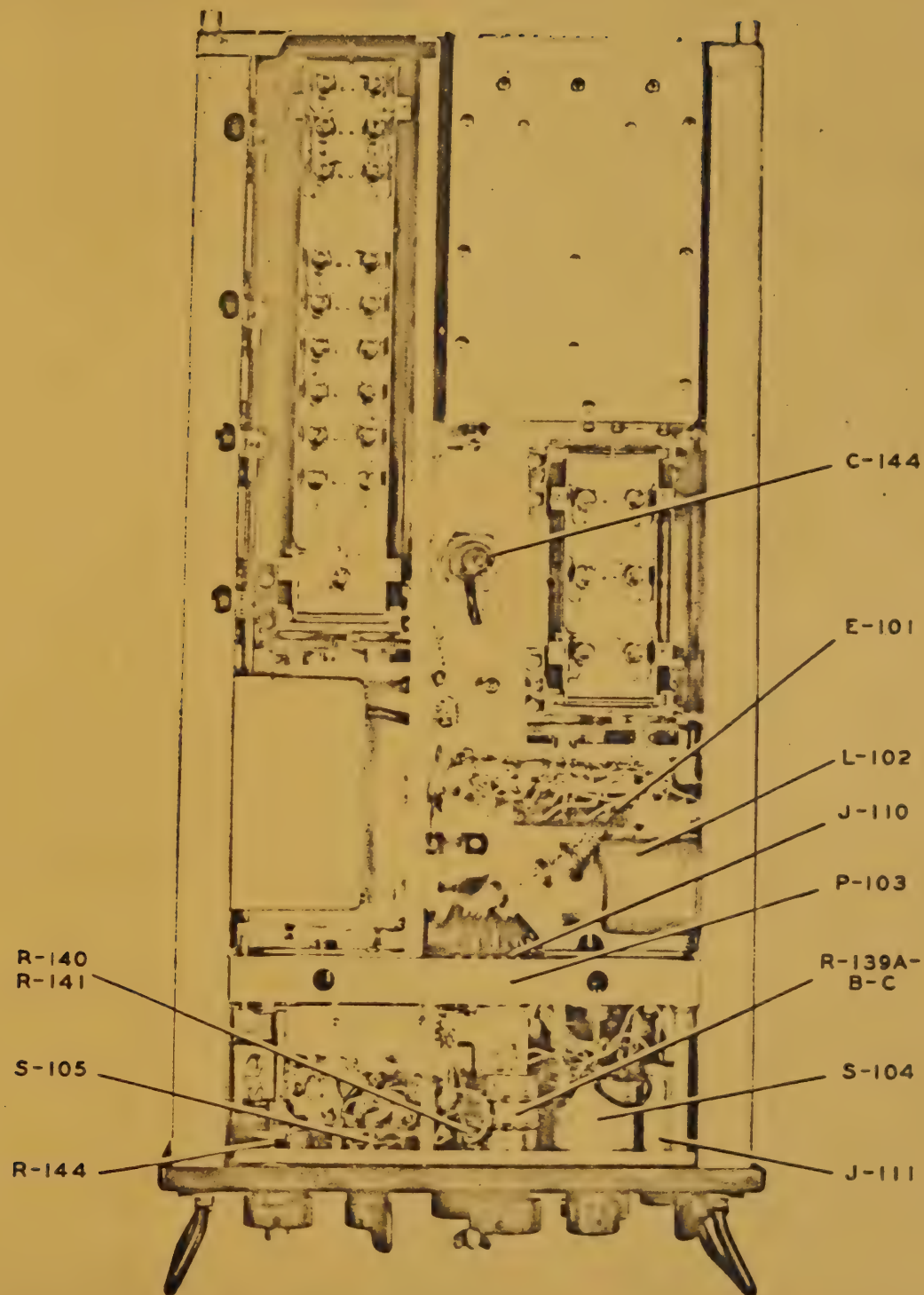


Figure 7-3 Receiver Bottom





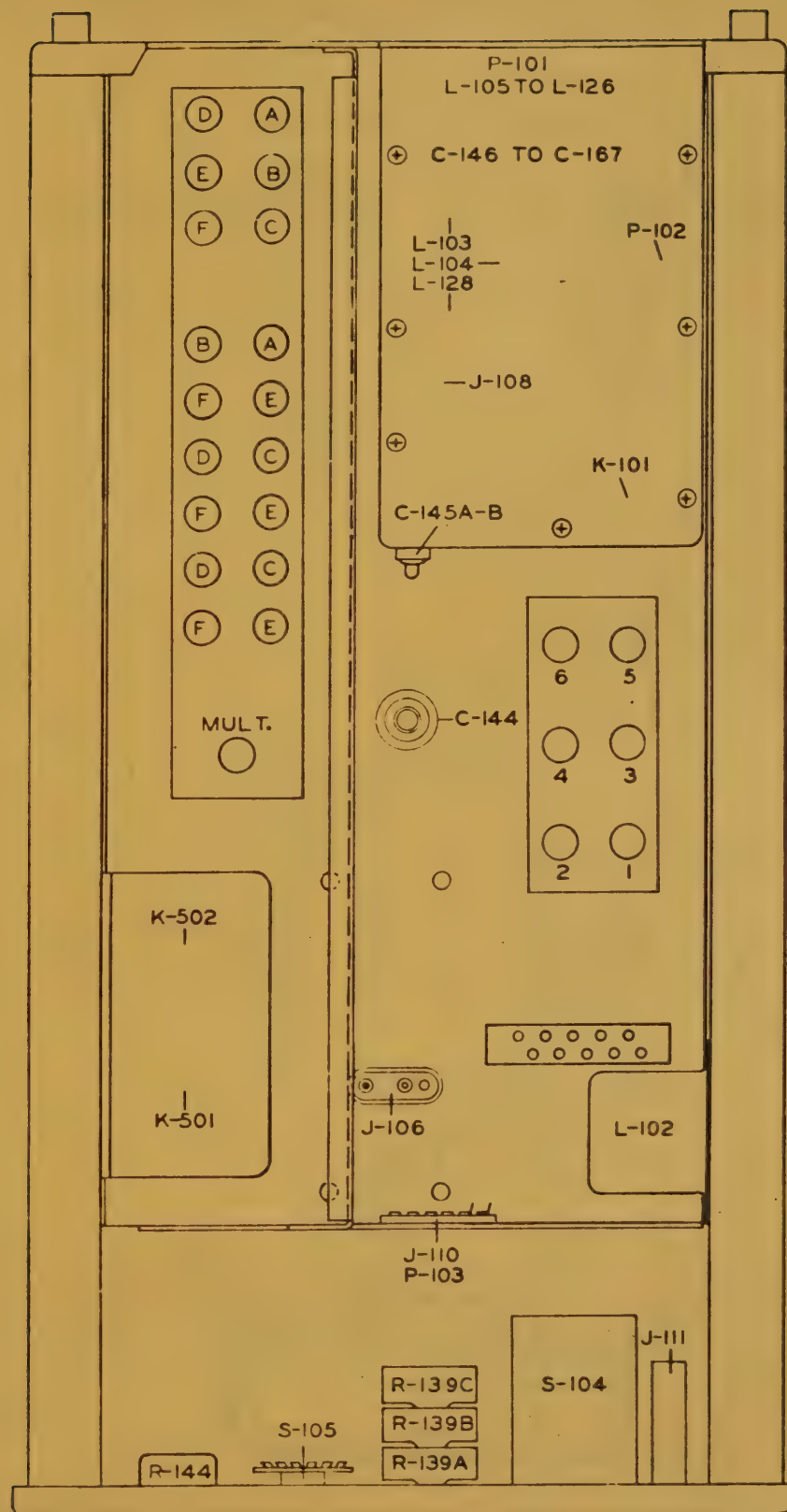


Figure 7-4 Receiver Parts Arrangement - Bottom



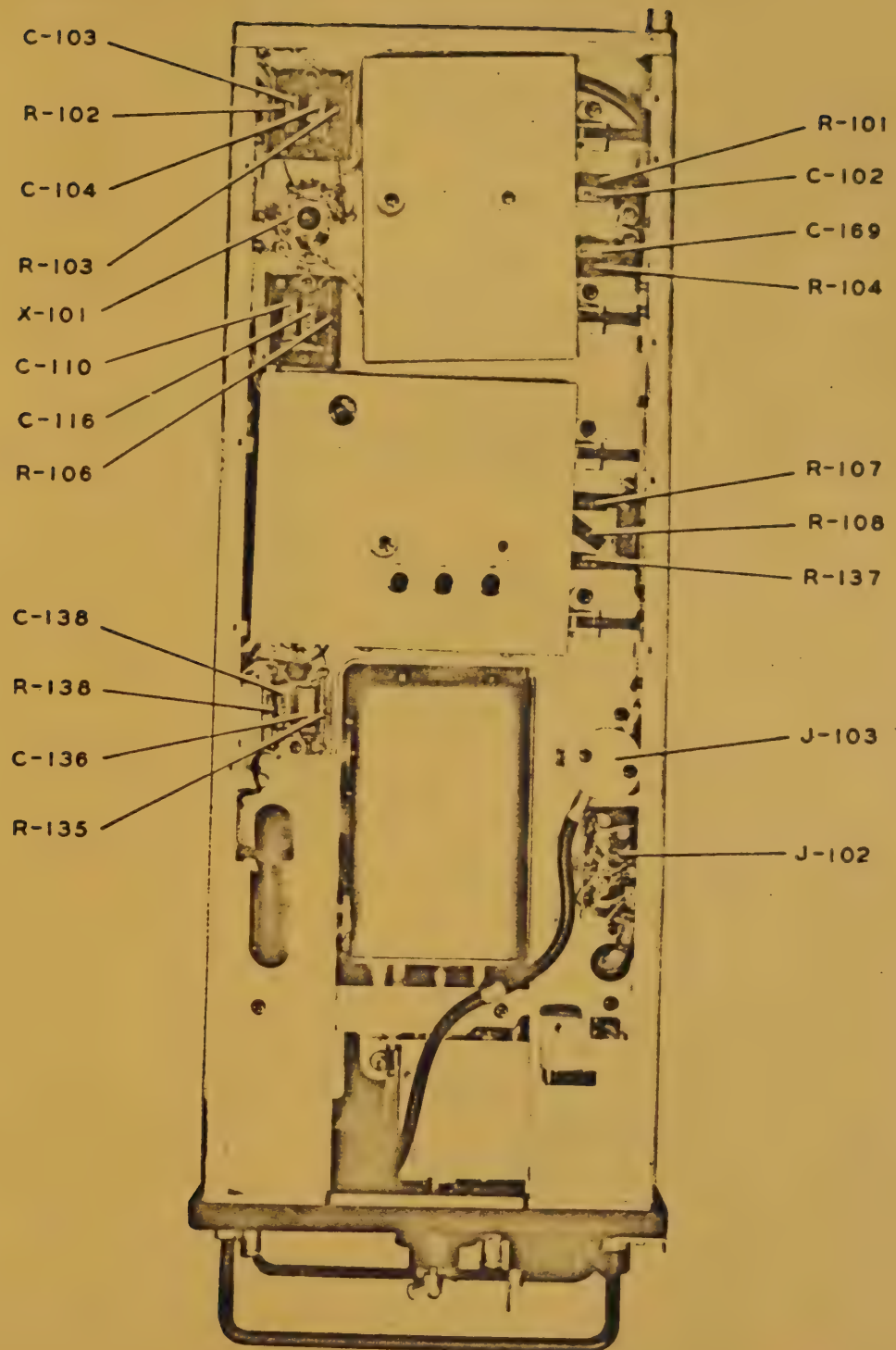


Figure 7-5 Receiver - Right Side



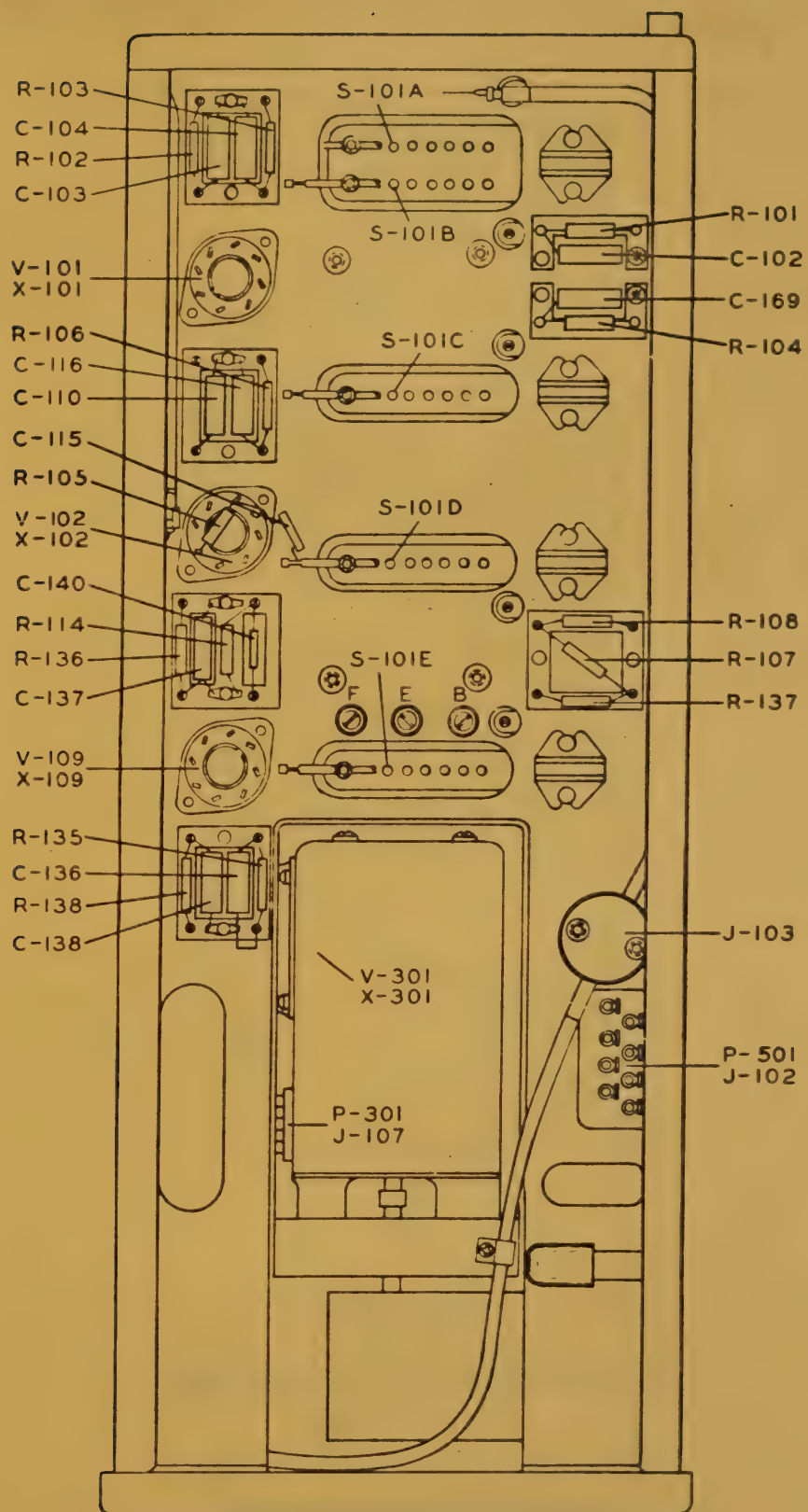


Figure 7-6 Receiver Parts Arrangement - Right Side





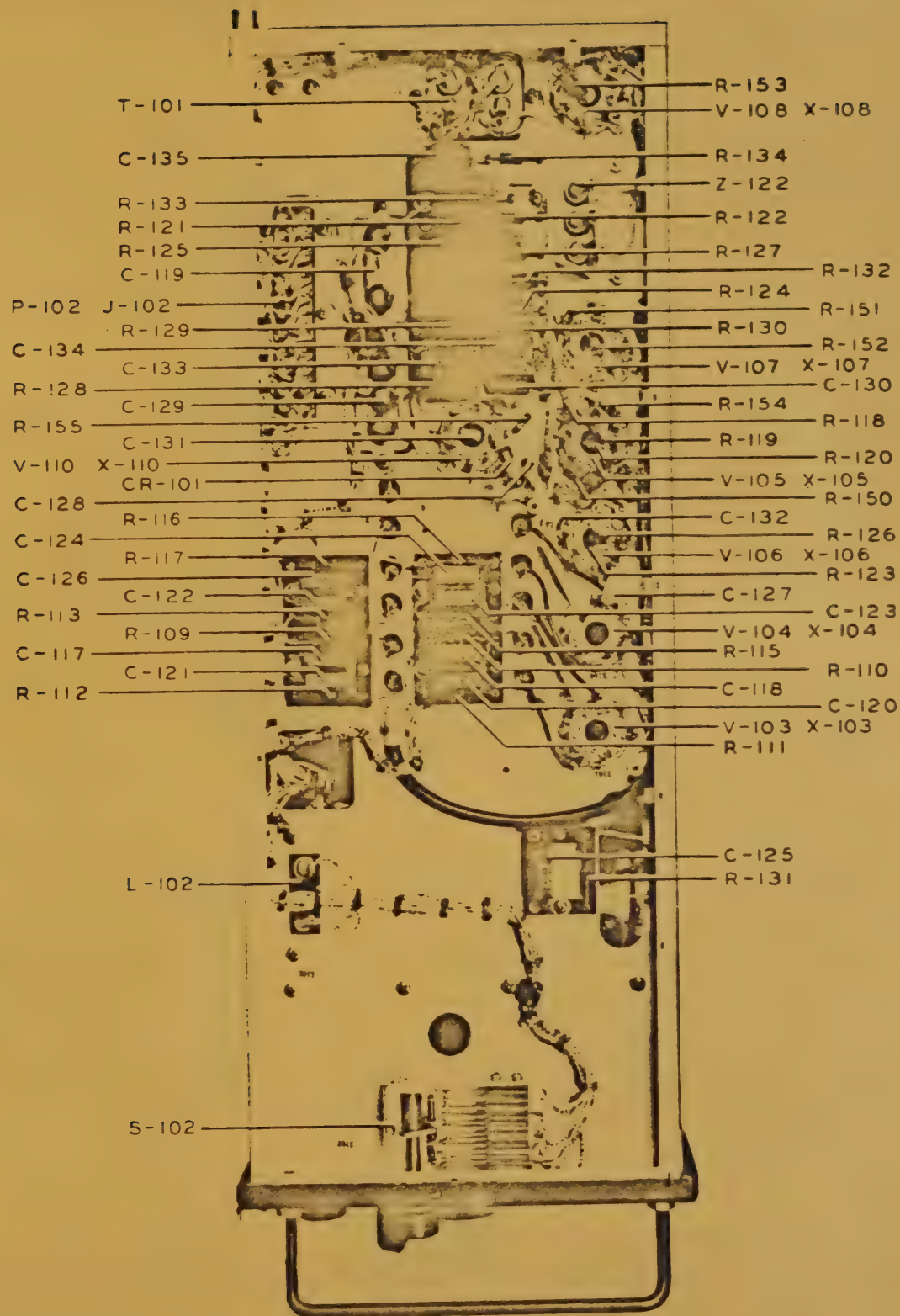


Figure 7-7 Receiver - Left Side



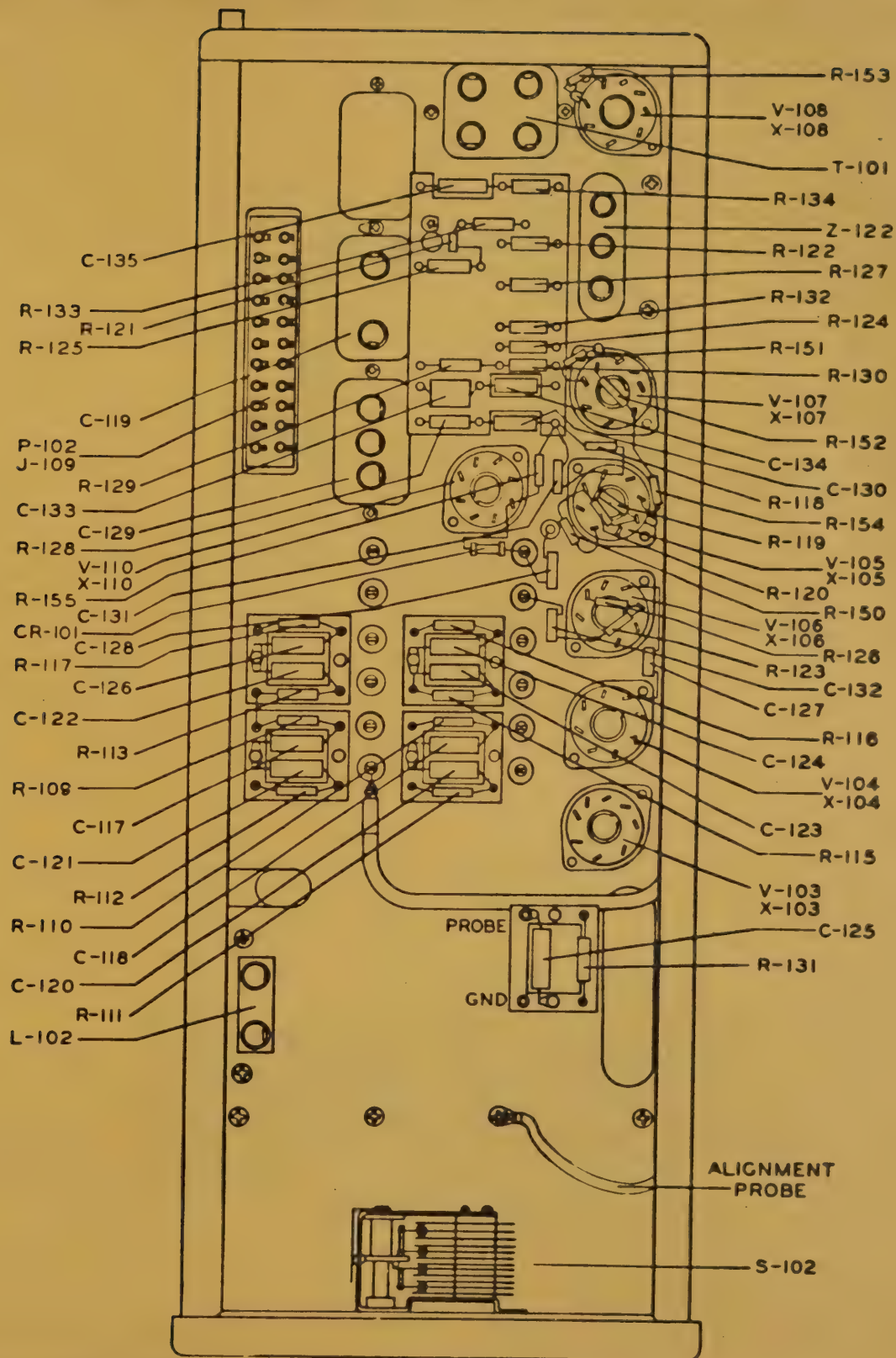


Figure 7-8 Receiver Parts Arrangement - Left Side





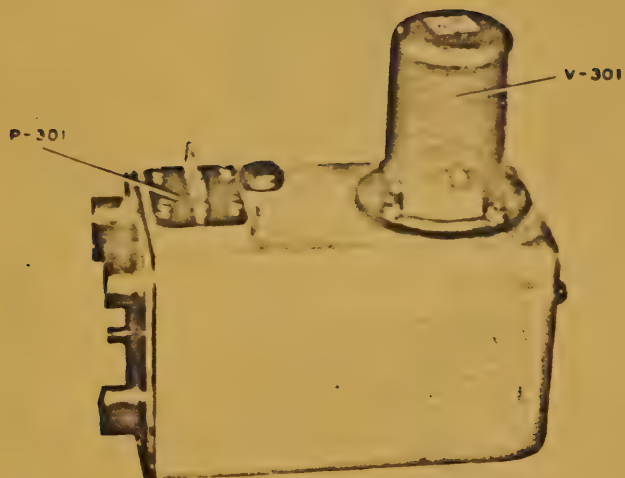


Figure 7-9 High Frequency Oscillator, Top Enclosed

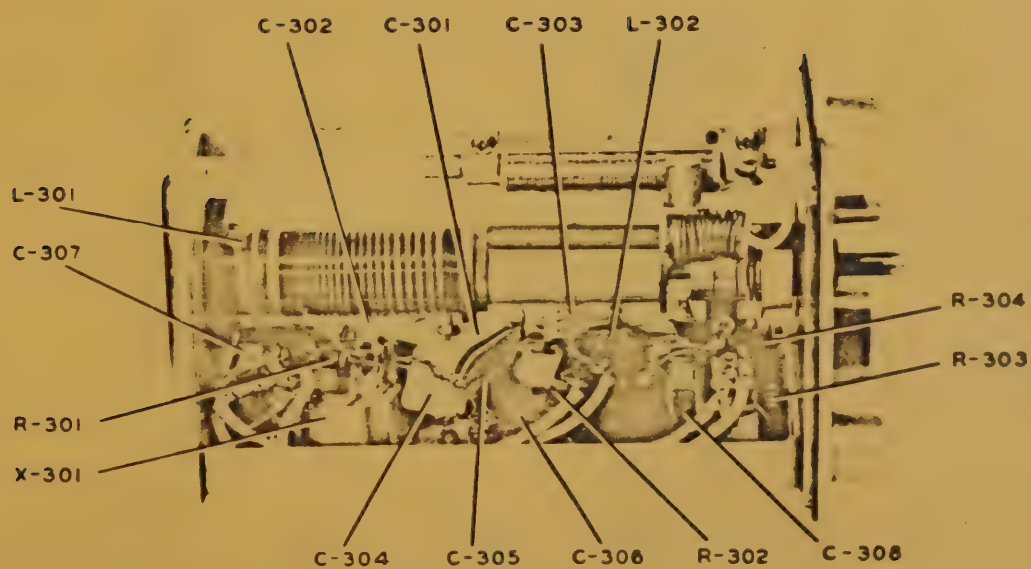


Figure 7-10 High Frequency Oscillator, Open.



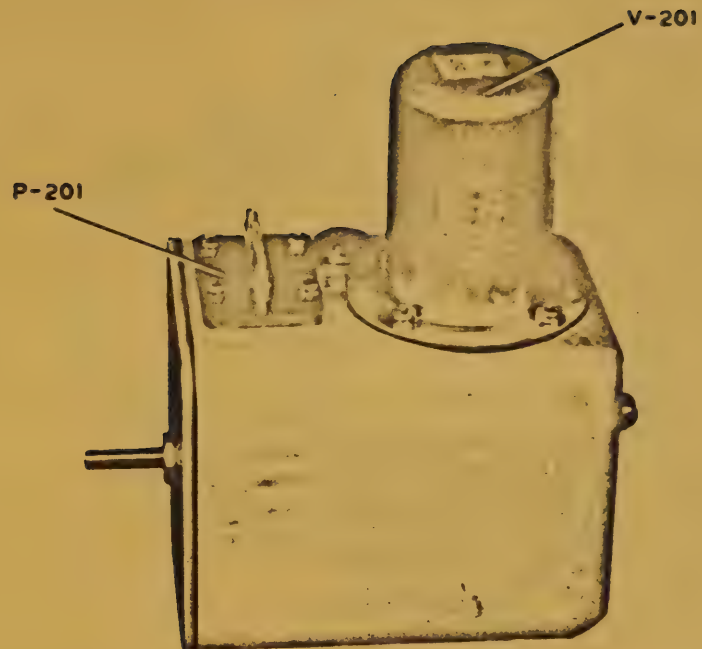


Figure 7-11 Low Frequency Oscillator, Top Enclosed

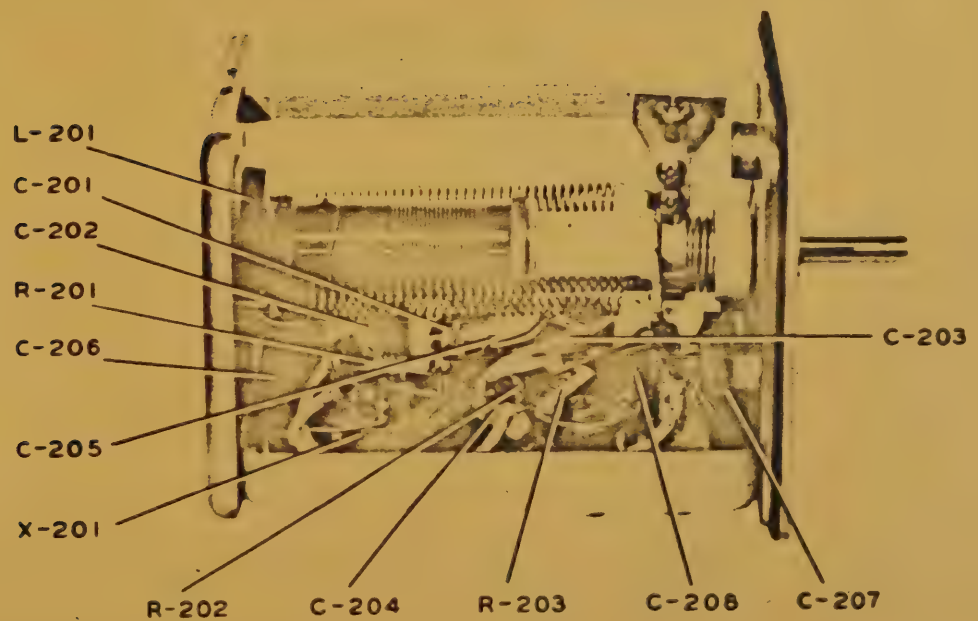


Figure 7-12 Low Frequency Oscillator, Open



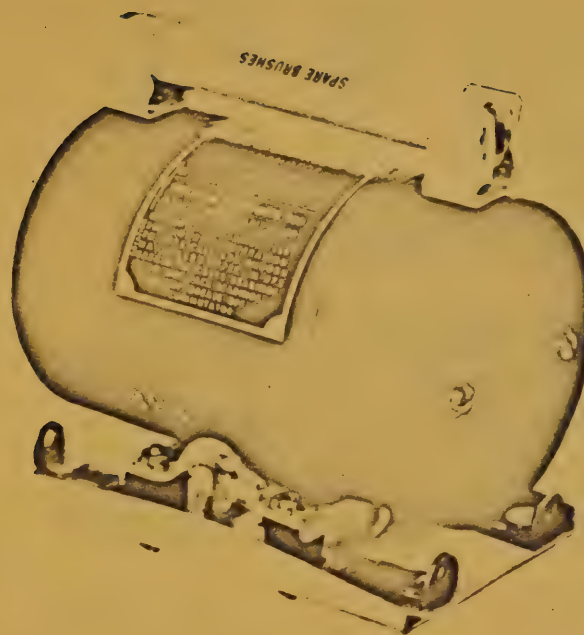


Figure 7-13 Dynamotor Unit



Figure 7-14 CFI Unit, Side Enclosed





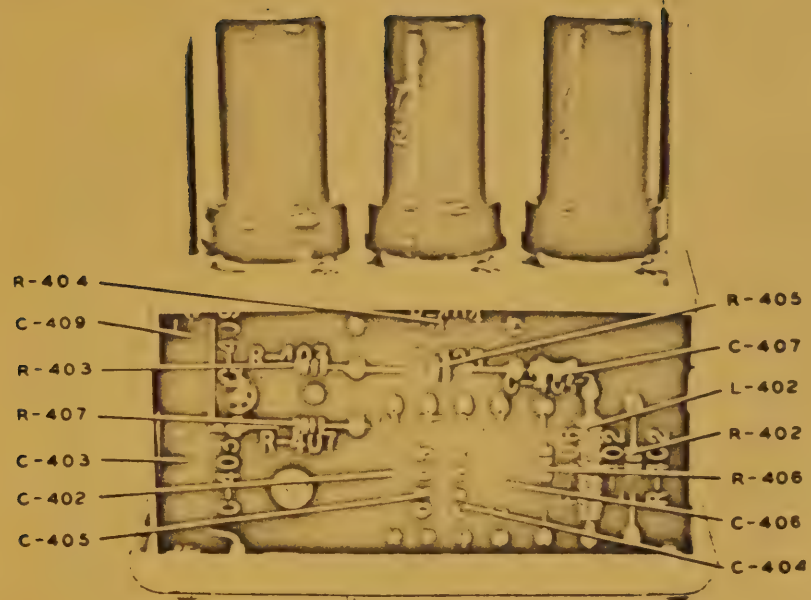


Figure 7-15 CFI Unit, Mounting Side

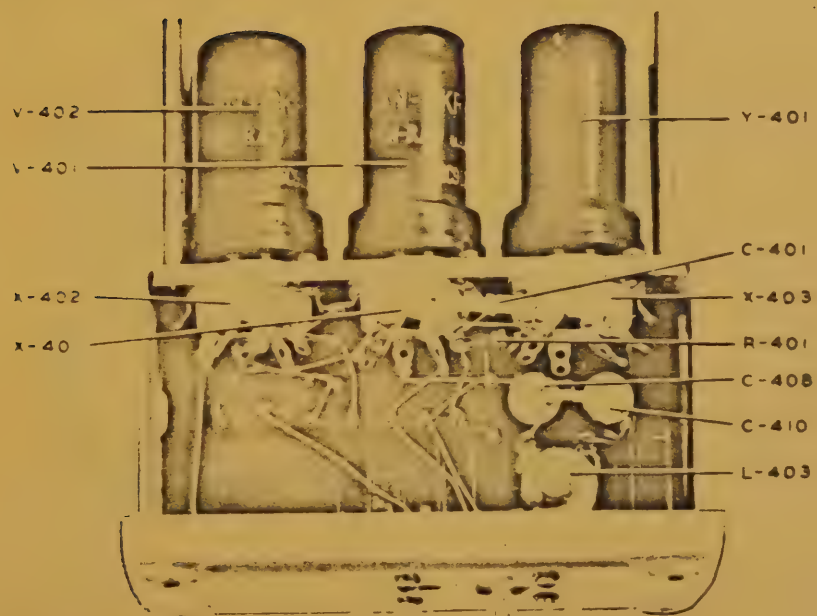


Figure 7-16 CFI Unit, Wired Side





Figure 7-17 Filter Unit, Bottom Enclosed

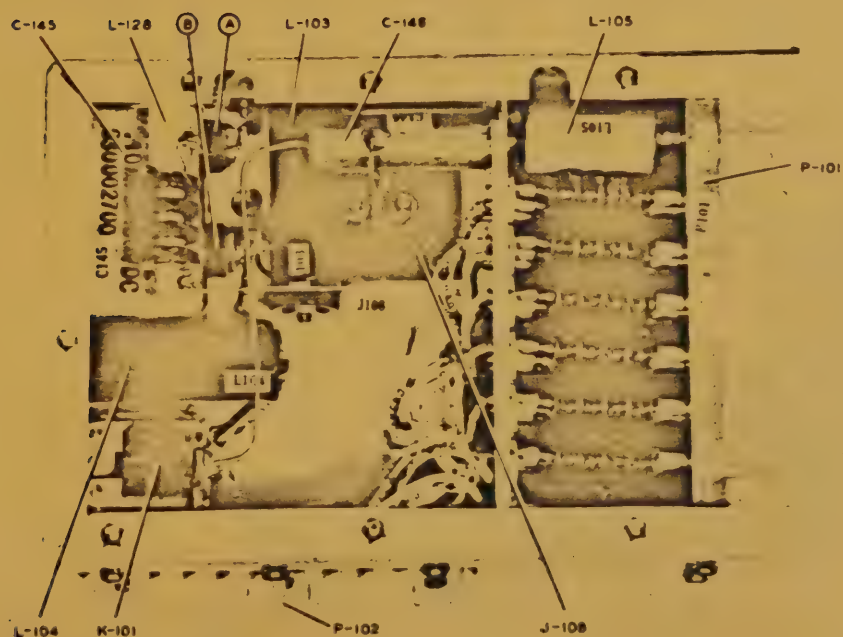


Figure 7-18 Filter Unit, Bottom Open





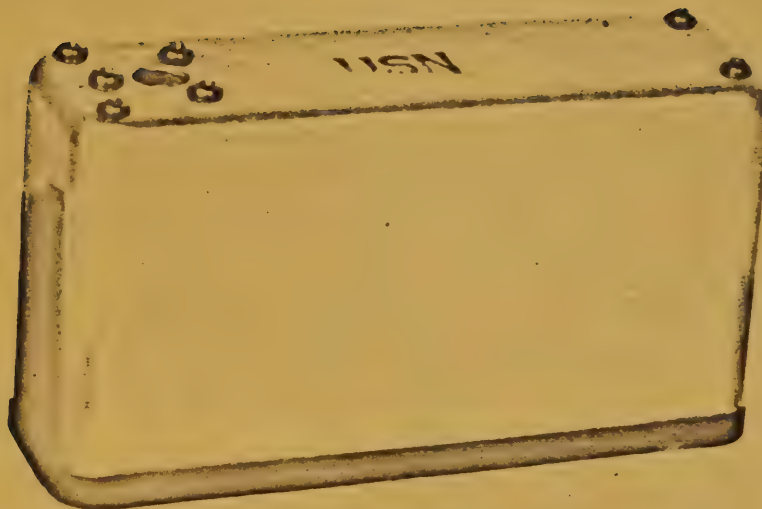


Figure 7-19 Relay Unit, Side Enclosed

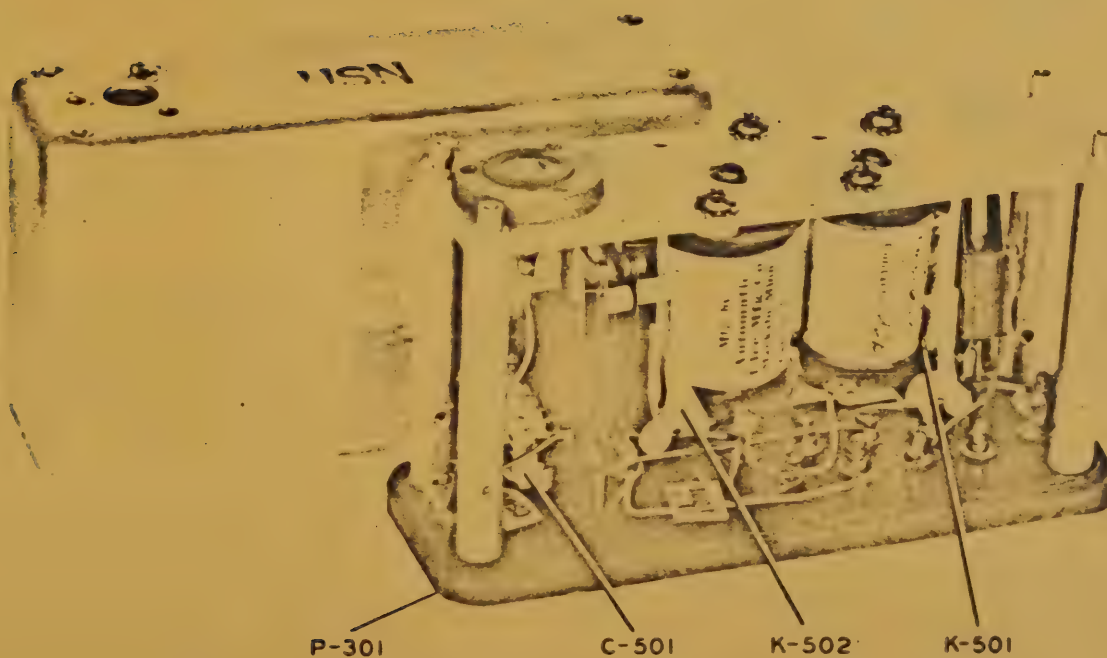


Figure 7-20 Relay Unit, Side Open



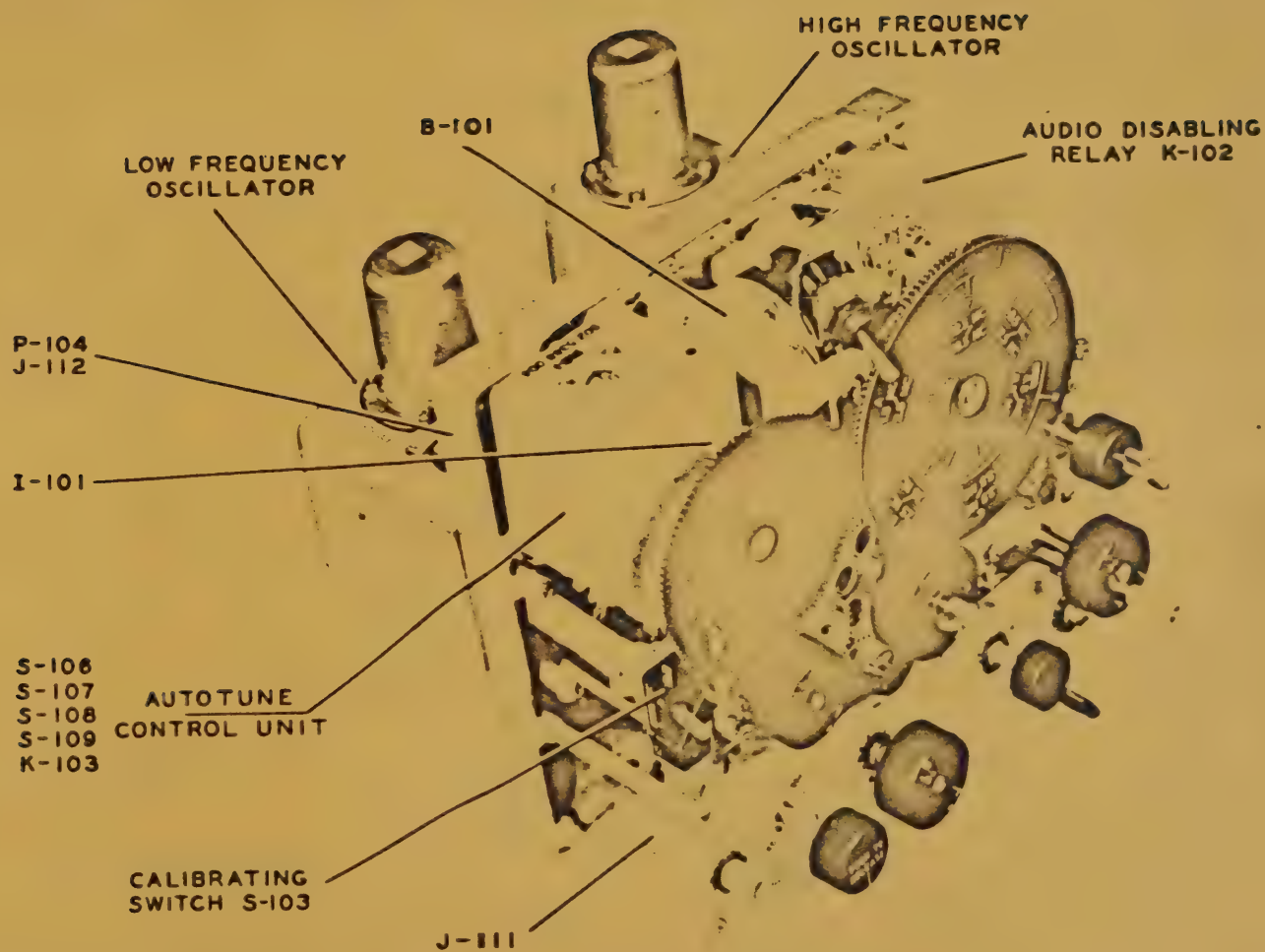


Figure 7-21 Autotune Casting Assembly, Top Left Oblique



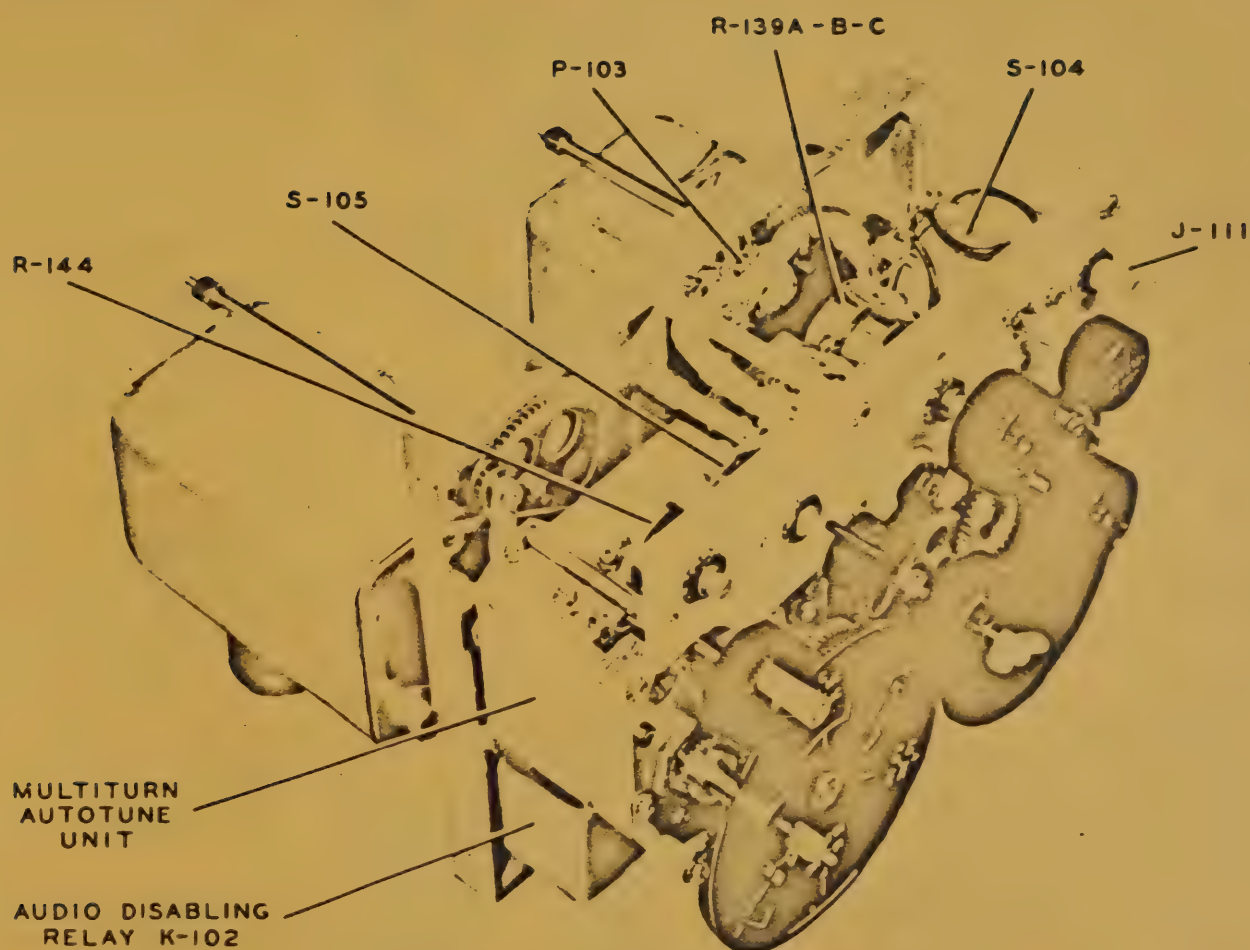


Figure 7-22 Autotune Casting Assembly, Bottom Right Oblique





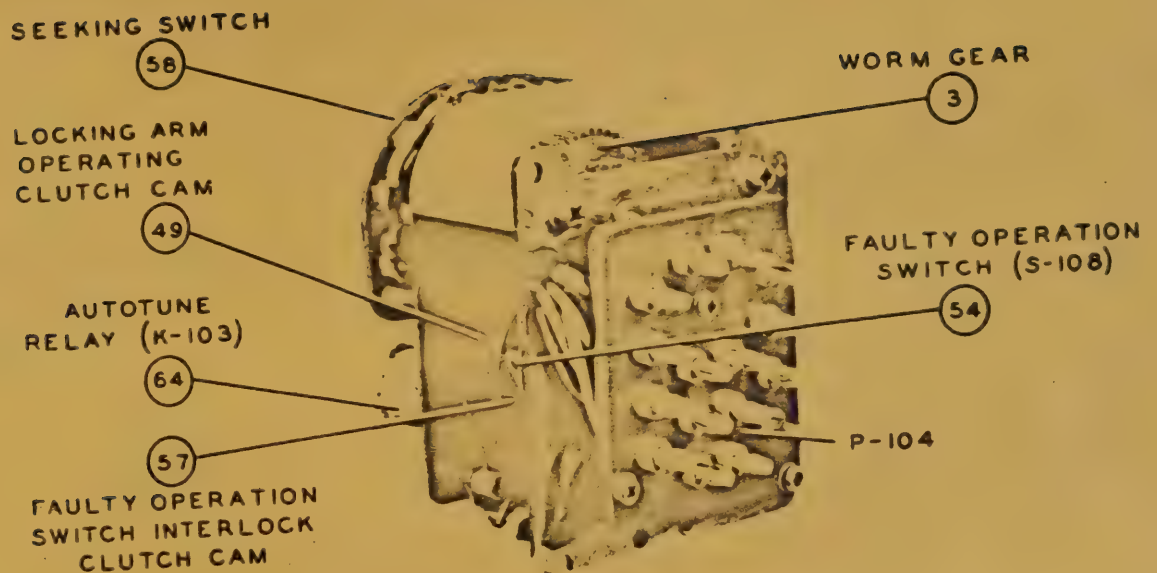


Figure 7-23 Autotune Control Unit, Rear View

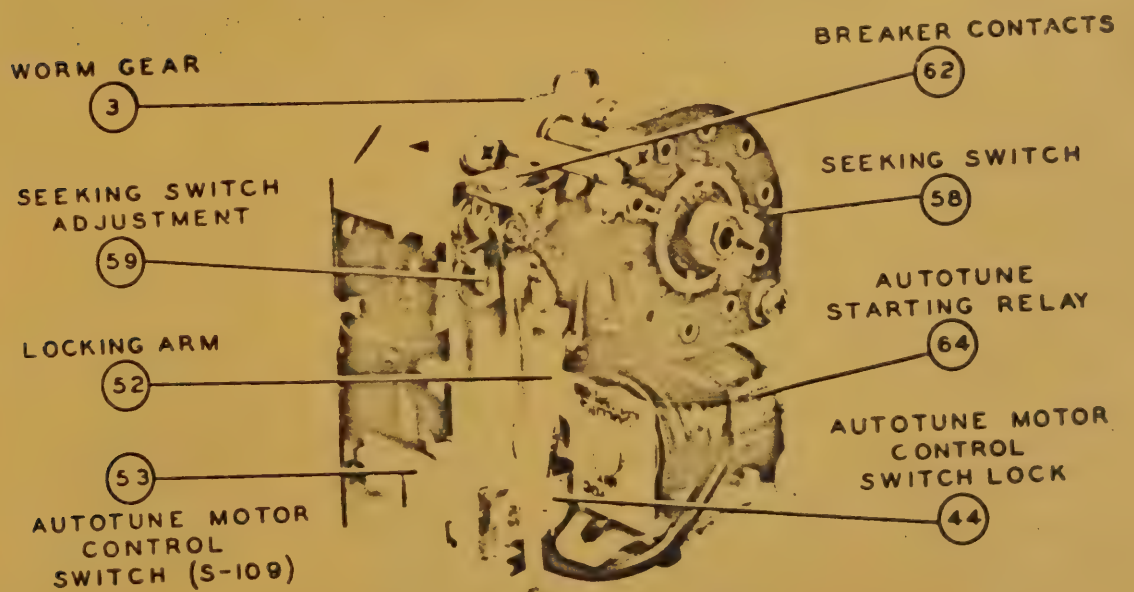
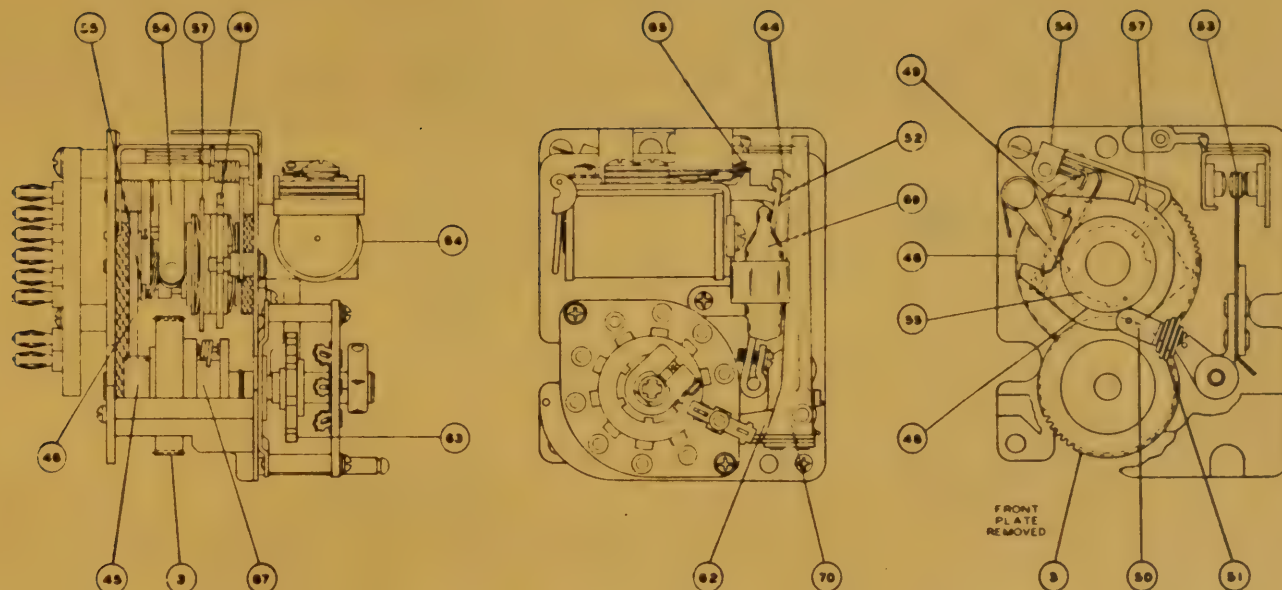


Figure 7-24 Autotune Control Unit, Front View





KEY TO SYMBOLS FOR CONTROL UNIT, MULTITUNE UNIT AND SINGLETUNE UNIT

- |                                   |                                   |                                  |
|-----------------------------------|-----------------------------------|----------------------------------|
| 1. Line Shaft                     | 28. Home Stop Ring                | 50. Locking Arm Operating        |
| 2. Drive Worm                     | 29. Home Stop Pawl                | Clutch Arm                       |
| 3. Worm Gear                      | (29A-Pawl Head)                   | 51. Locking Arm Operating        |
| 4. Slip Clutch Drive Gear         | (29B-Pawl Tail)                   | Clutch Arm Spring                |
| 5. Slip Clutch Idler Gear         | (29C-Pawl Toe)                    | 52. Locking Arm                  |
| 6. Slip Clutch Spur Gear          | 30. Stop Ring                     | 53. AUTOTUNE Motor Control       |
| 7. Slip Clutch Band Dog           | 31. Stop Ring Pawl                | Switch (S-109)                   |
| 8. Slip Clutch Band               | (31A-Pawl Head)                   | 54. Faulty Operation Switch      |
| 9. Slip Clutch Drum               | (31B-Pawl Tail)                   | (S-108)                          |
| 10. Counter Drum Drive Gear       | (31C-Pawl Toe)                    | 55. Faulty Operation Switch Cam  |
| 11. Counter Drum Idler Gear       | 32. Pawl Spring                   | 56. Faulty Operation Switch      |
| 12. Counter Drum Spur Gear        | 33. Stop Ring Drum Lock           | Interlock Arm                    |
| 13. Planetary Drive Gear          | 34. Tuning Knob Shaft             | 57. Faulty Operation Switch      |
| 14. Planetary Stationary Gear     | 35. Tuning Drive Gear             | Interlock Clutch Cam             |
| 15. Counter Drum Planetary Gear   | 36. Tuning Drive Limit Spline     | 58. Seeking Switch (S-106)       |
| 16. Cam Drum Idler Gear           | 37. Tuning Idler Gear             | 59. Seeking Switch Adjustment    |
| 17. Cam Drive Gear Assembly       | 38. Tuning Spur Gear              | 60. Seeking Switch Ratchet Dog   |
| 18. Cam Drum Spur Gear            | 39. Tuning Spur Gear Clutch       | 61. Seeking Switch Ratchet Tooth |
| 19. Cam Drum Ratchet Dog          | 40. Tuned Element                 | 62. Breaker Contacts (S-107)     |
| 20. Cam Drum Ratchet Tooth        | 41. Stop Bar                      | 63. Breaker Cam                  |
| 21. Cam Drum                      | 42. Stop Ring Drum Drive          | 64. AUTOTUNE Starting Relay      |
| 22. Counter Drum Slot Ring        | 43. Cam Drum Drive Gear           | 65. AUTOTUNE Starting Relay      |
| 23. Counter Drum Slot Ring Pawl   | 44. AUTOTUNE Motor Control Switch | Contacts                         |
| (23A-Pawl Head)                   | Lock                              | 66. Locking Arm Operating        |
| (23B-Pawl Tail)                   | 45. Locking Arm Drive Gear        | Clutch Spring                    |
| (23C-Pawl Toe)                    | 46. Locking Arm Spur Gear         | 67. Single Tooth Ratchet         |
| 24. Counter Drum Home Stop Gear   | 47. Locking Arm Engage Collar     | Assembly                         |
| 25. Home Stop Pawl Operating Gear | 48. Locking Arm Operating Clutch  | 68. Seeking Switch Locking       |
| 26. Pawl Lifting Toggle Lever     | Drum                              | Collar                           |
| 27. Pawl Lifting Toggle           | 49. Locking Arm Operating Clutch  | 69. Neon Bulb (surge absorber)   |
|                                   | Cam                               |                                  |

Figure 7-25 Control Unit Sections





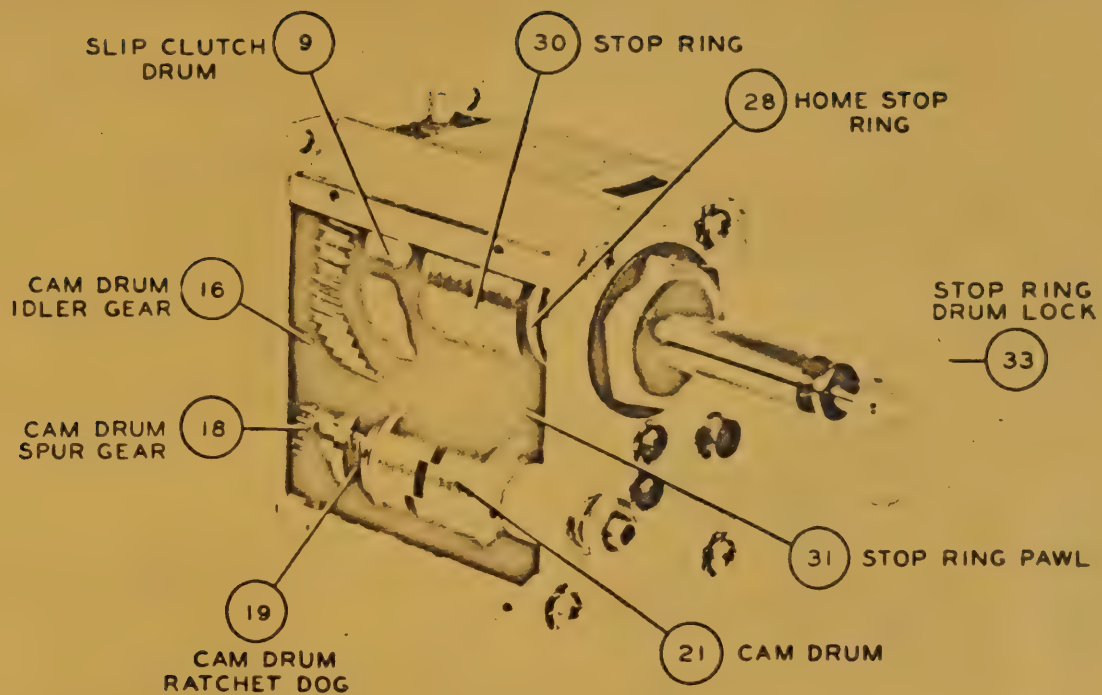


Figure 7-26 Singleturn Unit, Front View

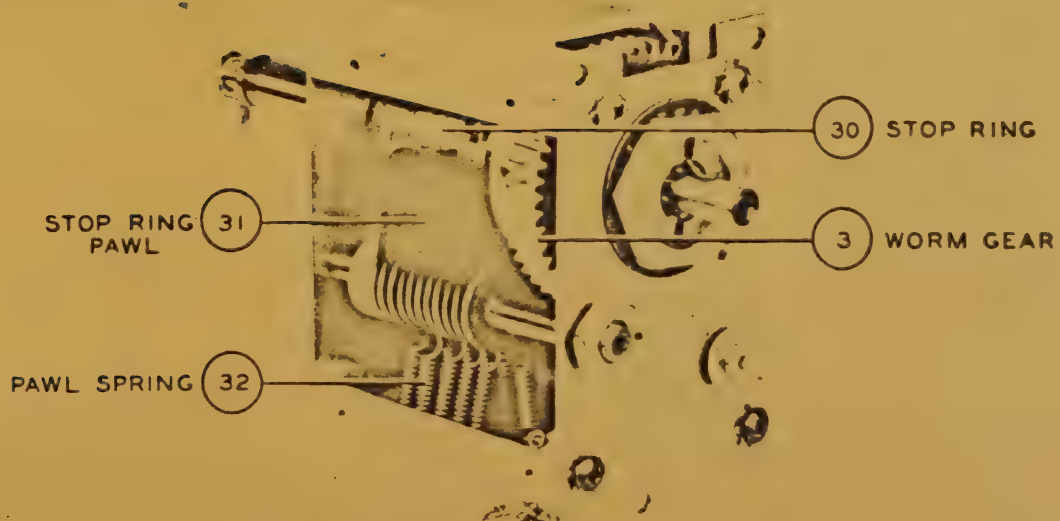
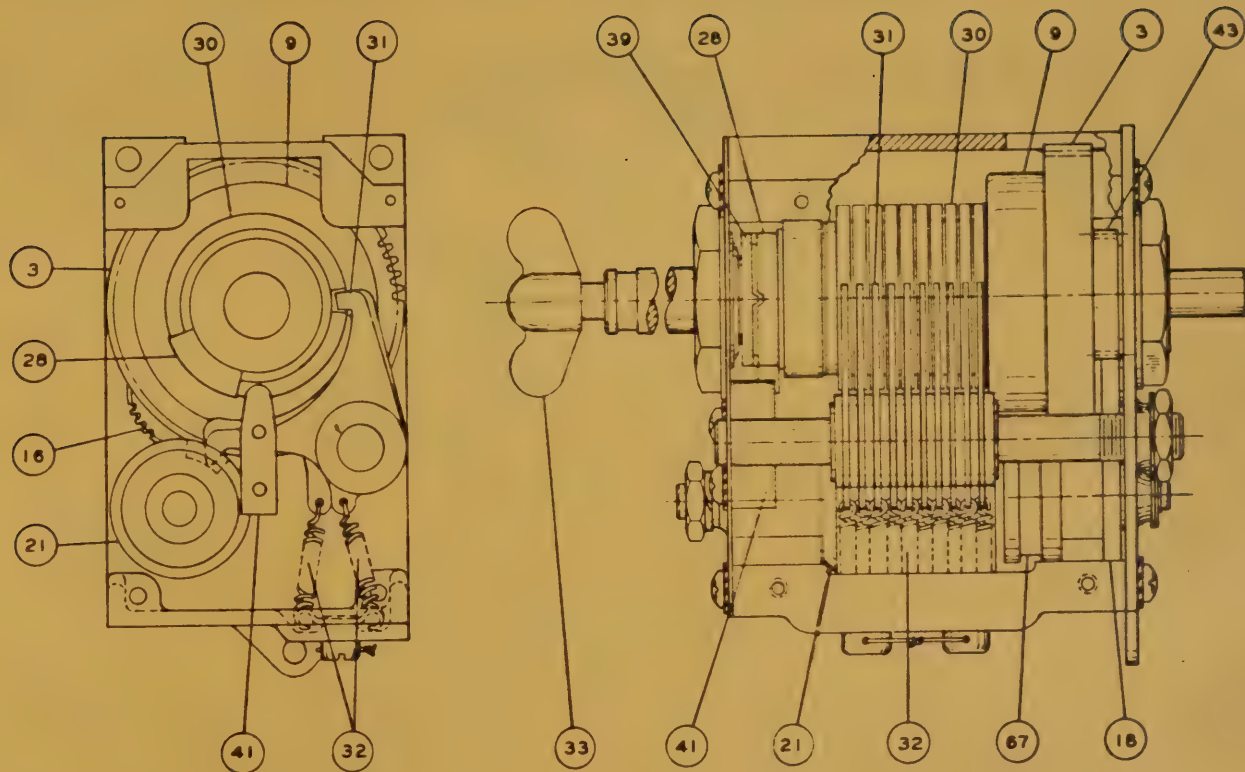


Figure 7-27 Singleturn Unit, Rear View





#### KEY TO SYMBOLS

- |                                 |                                       |
|---------------------------------|---------------------------------------|
| 1. Line Shaft                   | 24. Counter Drum Home Stop Drive Gear |
| 2. Drive Worm                   | 25. Home Stop Pawl Operating Gear     |
| 3. Worm Gear                    | 26. Anvil Operating Clutch Arm        |
| 4. Slip Clutch Drive Gear       | 27. Anvil                             |
| 5. Slip Clutch Idler Gear       | 28. Home Stop Pawl                    |
| 6. Slip Clutch Spur Gear        | 29. Home Stop Pawl                    |
| 7. Slip Clutch Bent Dog         | (29A-Pawl Head)                       |
| 8. Slip Clutch Bent Dog         | (29B-Pawl Tail)                       |
| 9. Slip Clutch Drum             | (29C-Pawl Toe)                        |
| 10. Counter Drum Drive Gear     | 30. Stop Ring                         |
| 11. Counter Drum Idler Gear     | 31. Stop Ring Pawl                    |
| 12. Counter Drum Spur Gear      | (31A-Pawl Head)                       |
| 13. Planetary Drive Gear        | (31B-Pawl Tail)                       |
| 14. Planetary Stationary Gear   | (31C-Pawl Toe)                        |
| 15. Counter Drum Planetary Gear | 32. Pawl Spring                       |
| 16. Cam Drum Idler Gear         | 33. Stop Ring Drum Lock               |
| 17. Cam Drum Idler Gear #2      | 34. Tuning Bent Shaft                 |
| 18. Cam Drum Spur Gear          | 35. Tuning Drive Gear                 |
| 19. Cam Drum Katchet Dog        | 36. Tuning Drive Limit Spline         |
| 20. Cam Drum Katchet Tooth      | 37. Tuning Idler Gear                 |
| 21. Cam Drum                    | 38. Tuning Spur Gear                  |
| 22. Counter Drum Slot Ring      | 39. Tuning Spur Gear Clutch           |
| 23. Counter Drum Slot Ring Pawl | 40. Tuned Element                     |
| (23A-Pawl Head)                 | 41. Stop Bar                          |
| (23B-Pawl Tail)                 | 42. Stop Ring Drum Drive              |
| (23C-Pawl Toe)                  | 43. Cam Drum Drive Gear               |

Figure 7-28 Singleturn Unit, Sections



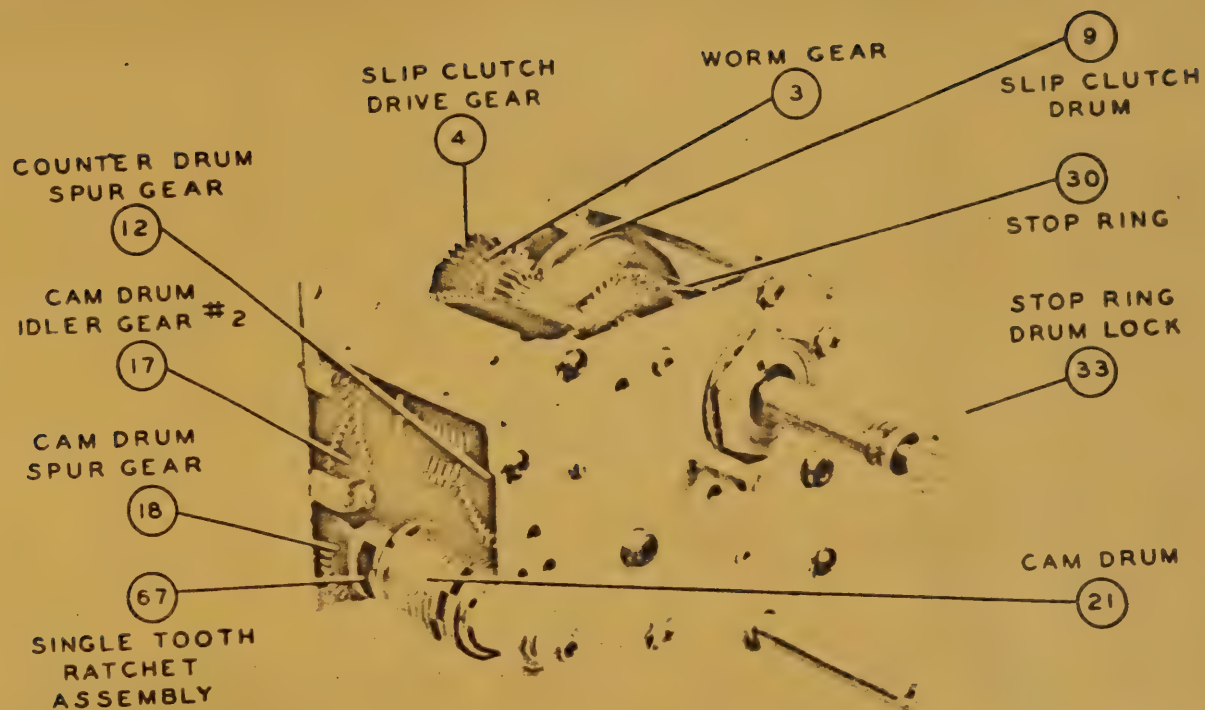


Figure 7-29 Multiturn Unit, Front

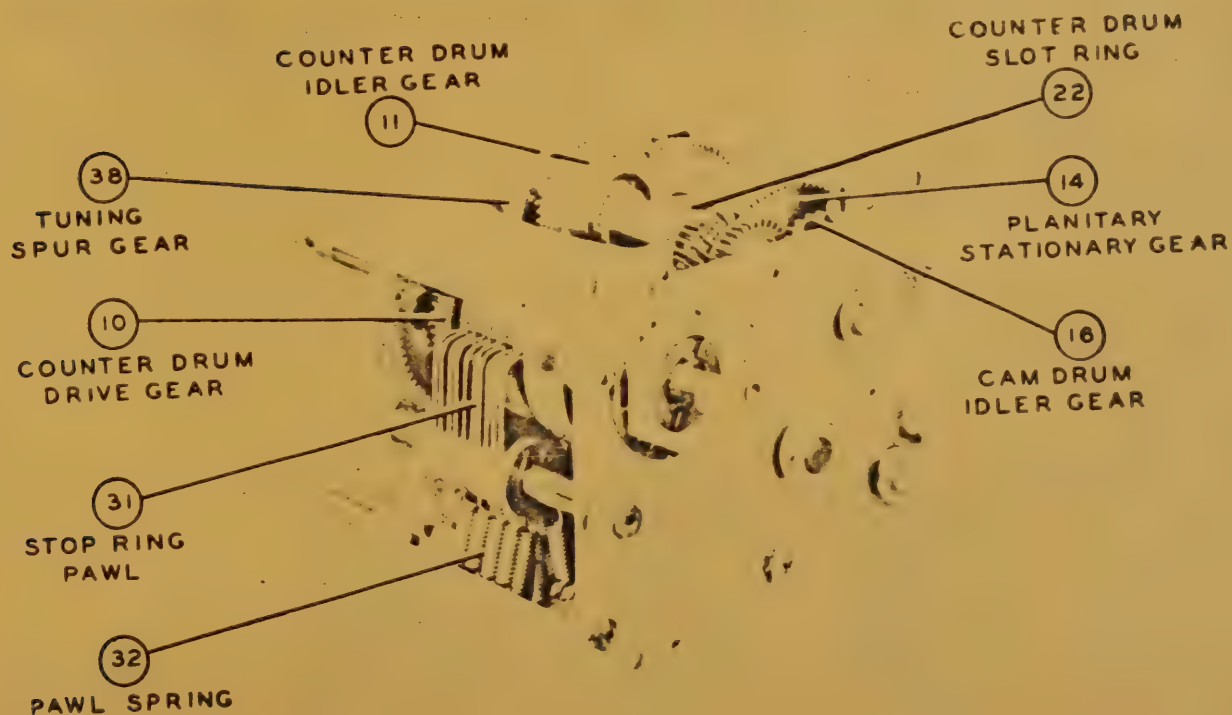
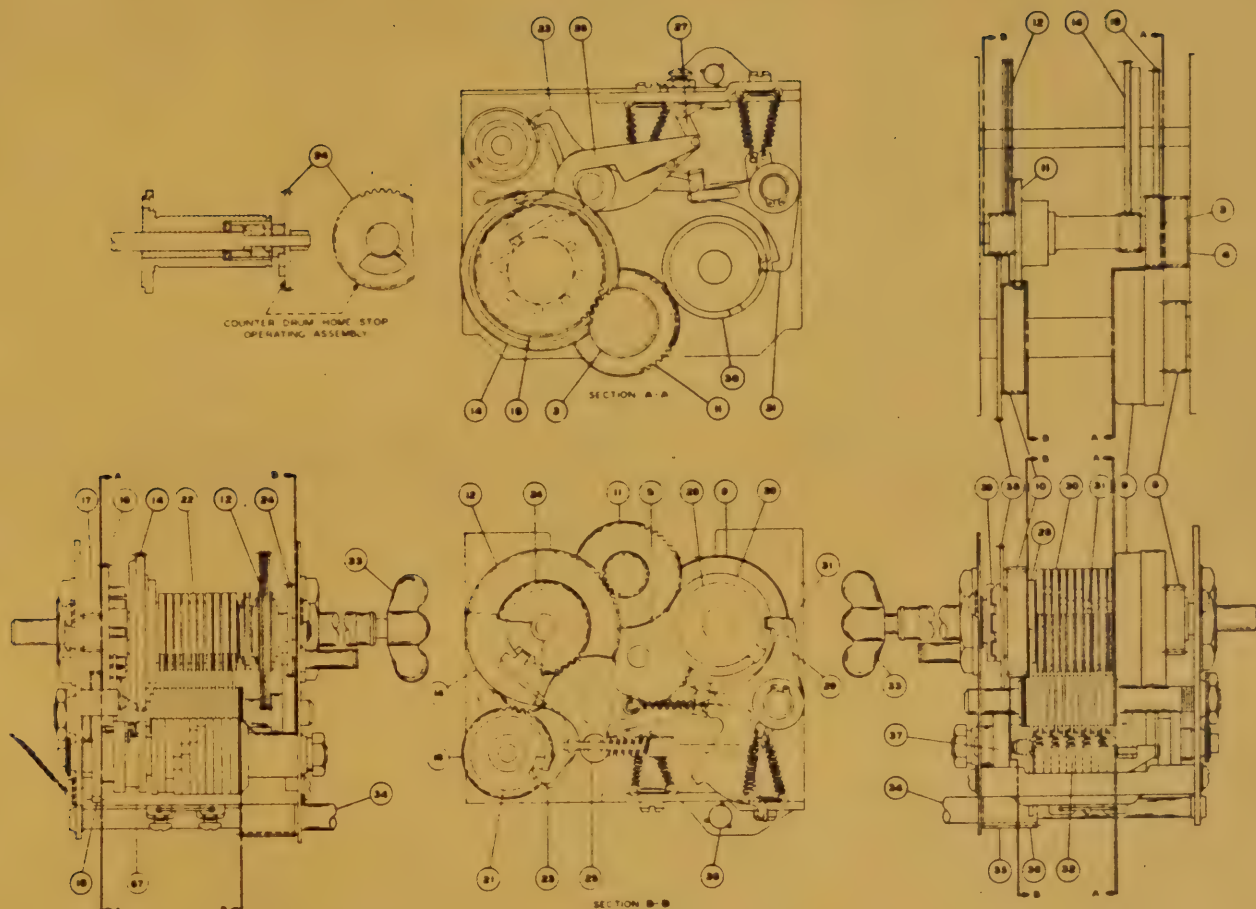


Figure 7-30 Multiturn Unit, Rear





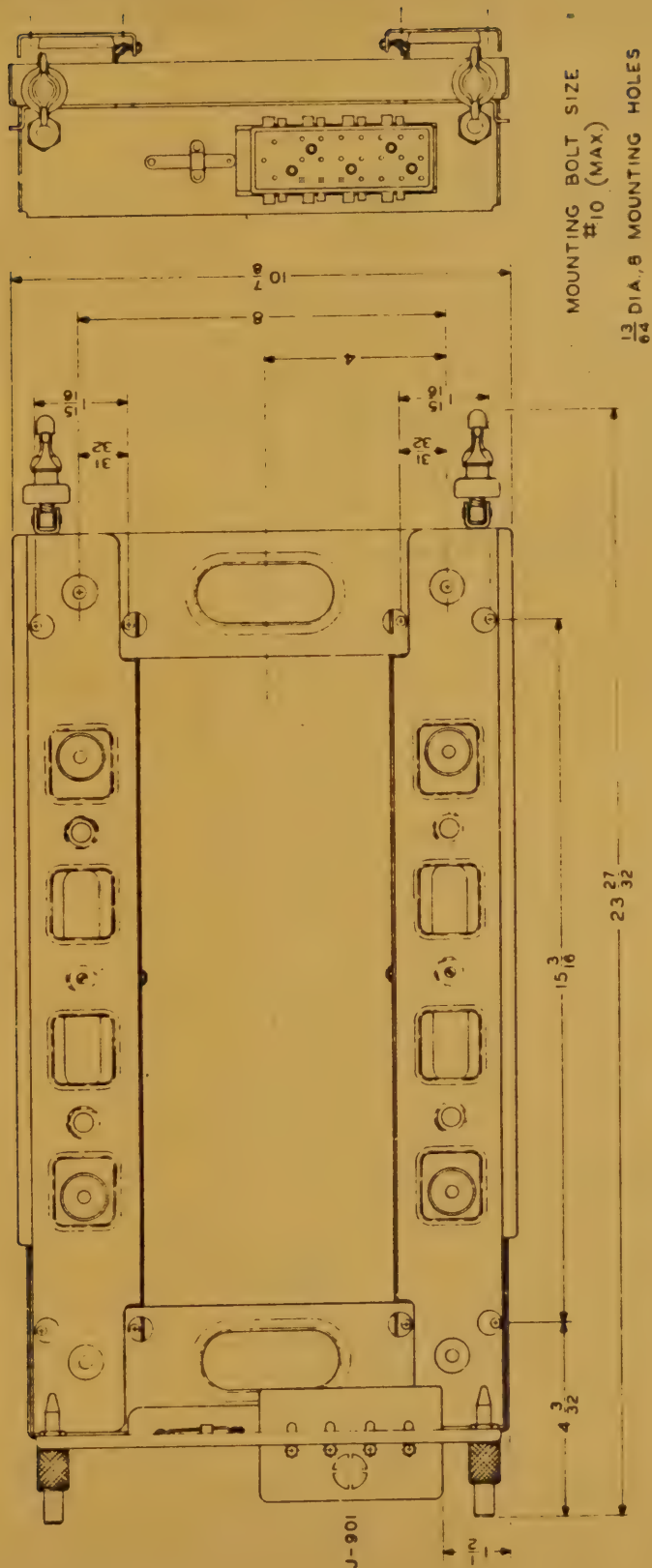


# KEY TO SYMBOLS

- |                                 |                               |                    |
|---------------------------------|-------------------------------|--------------------|
| 1. Line Shaft                   | 19. Can Drum Hatchet Dog      | 30. Stop Ring      |
| 2. Drive Worm                   | 20. Can Drum Hatchet Tooth    | 31. Stop Ring Pawl |
| 3. Worm Gear                    | 21. Can Drum                  | (31A-Pawl Head)    |
| 4. Slip Clutch Drive Gear       | 22. Counter Drum Slot Ring    | (31B-Pawl Tail)    |
| 5. Slip Clutch Idler Gear       | 23. Counter Drum Slot         | (31C-Pawl Toe)     |
| 6. Slip Clutch Spur Gear        | 24. Ring Pawl                 |                    |
| 7. Slip Clutch Band Dog         | (24A-Pawl Head)               |                    |
| 8. Slip Clutch Band             | (24B-Pawl Tail)               |                    |
| 9. Slip Clutch Drum             | (24C-Pawl Toe)                |                    |
| 10. Counter Drum Drive Gear     | 25. Counter Drum Home Stop    |                    |
| 11. Counter Drum Idler Gear     | Drive Gear                    |                    |
| 12. Counter Drum Spur Gear      | 26. Home Stop Pawl Operating  |                    |
| 13. Planetary Drive Gear        | Gear                          |                    |
| 14. Planetary Stationary Gear   | 27. Pawl Lifting Toggle Lever |                    |
| 15. Counter Drum Planetary Gear | 28. Pawl Lifting Toggle       |                    |
| 16. Can Drum Idler Gear         | 29. Home Stop Ring            |                    |
| 17. Can Drum Idler Gear #2      | (29A-Pawl Head)               |                    |
| 18. Can Drum Spur Gear          | (29B-Pawl Tail)               |                    |
|                                 | (29C-Pawl Toe)                |                    |
|                                 | 32. Pawl Spring               |                    |
|                                 | 33. Stop Ring Drum Lock       |                    |
|                                 | 34. Tuning Knob               |                    |
|                                 | 35. Tuning Drive Gear         |                    |
|                                 | 36. Tuning Drive Limit Spline |                    |
|                                 | 37. Tuning Idler Gear         |                    |
|                                 | 38. Tuning Spur Gear          |                    |
|                                 | 39. Tuning Spur Gear Clutch   |                    |
|                                 | 40. Tuned Element             |                    |
|                                 | 41. Stop Bar                  |                    |
|                                 | 42. Stop Ring Drum Drive      |                    |
|                                 | 43. Can Drum Drive Gear       |                    |

Figure 7-31 Multiturn, Sections





WEIGHT - 4 LBS

NOTE: ALL DIMENSIONS ARE  
IN INCHES.

MOUNTING BASE USED WITH 31H-3  
AIRCRAFT RADIO EQUIPMENT



Figure 7-32 Mounting Base Dimensions





NOTE: ALL DIMENSIONS ARE IN INCHES.

CLEARANCES

FRONT OF UNIT

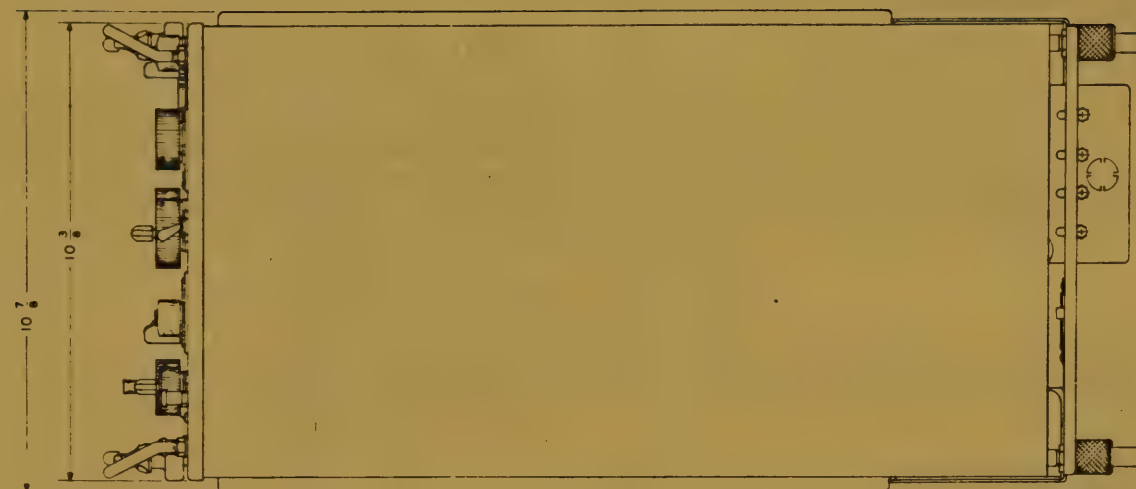
4" FOR REMOVAL OF UNIT  
18" FOR ADJUSTING CONTROLS

REAR OF UNIT

3" FOR REMOVAL OF CONNECTOR  
PLUG FROM SHOCKMOUNT AND  
VENTILATION

4" IF CABLE COMES DIRECTLY FROM  
REAR OF CONNECTOR PLUG

$\frac{1}{2}$ " FOR FREE MOVEMENT IN ANY  
DIRECTION ON SHOCKMOUNT



WEIGHT UNCRATED

RECEIVER UNIT - 39.5 LBS.

MOUNTING BASE - 4.0 LBS.

TOTAL 43.5 LBS.

POWER SOURCE  
REQUIRED

26.5 VOLTS D.C.  
2.75 AMP OPERATION  
1.6 AMP DURING CHANNEL  
SELECTION

VACUUM TUBES

5-12SG7

1-12H6

5-12SJ7

1-12A6

2-12SL7

AUDIO POWER OUTPUT

500 MILLIWATTS

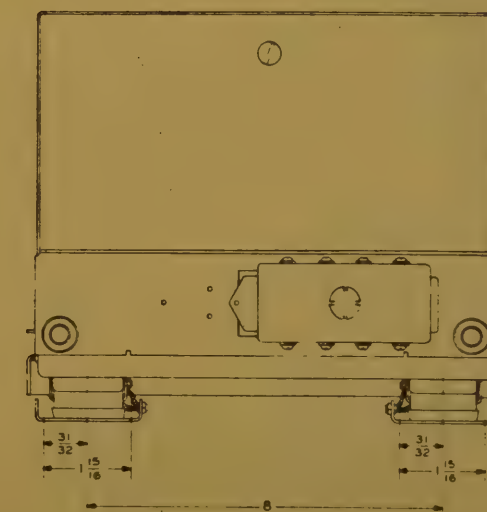
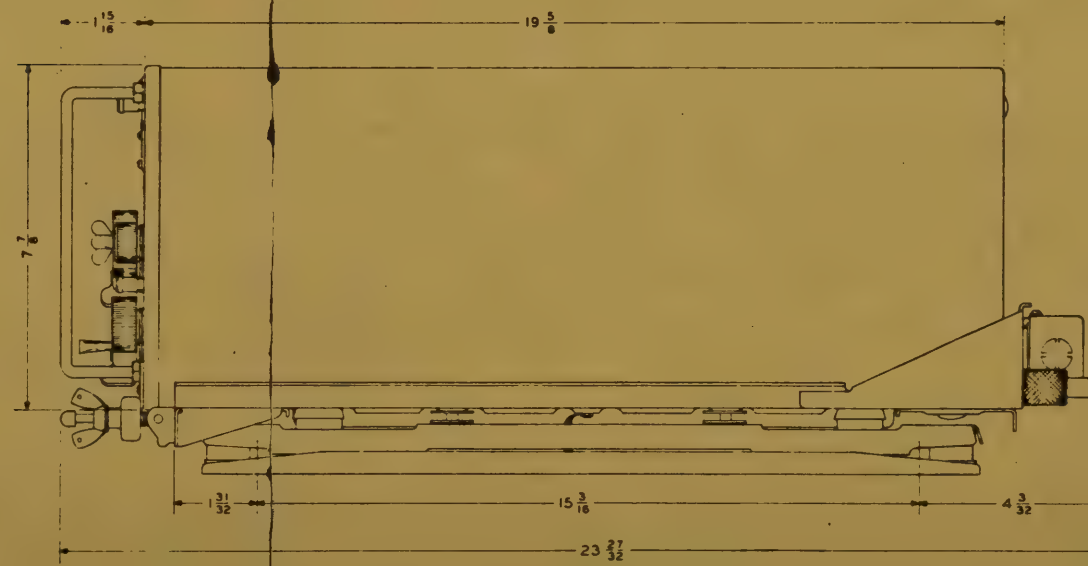
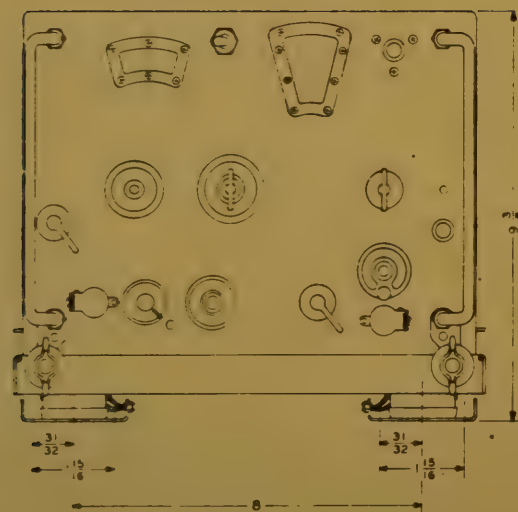


Figure 7-33 Receiver Outline and Mounting Dimensions



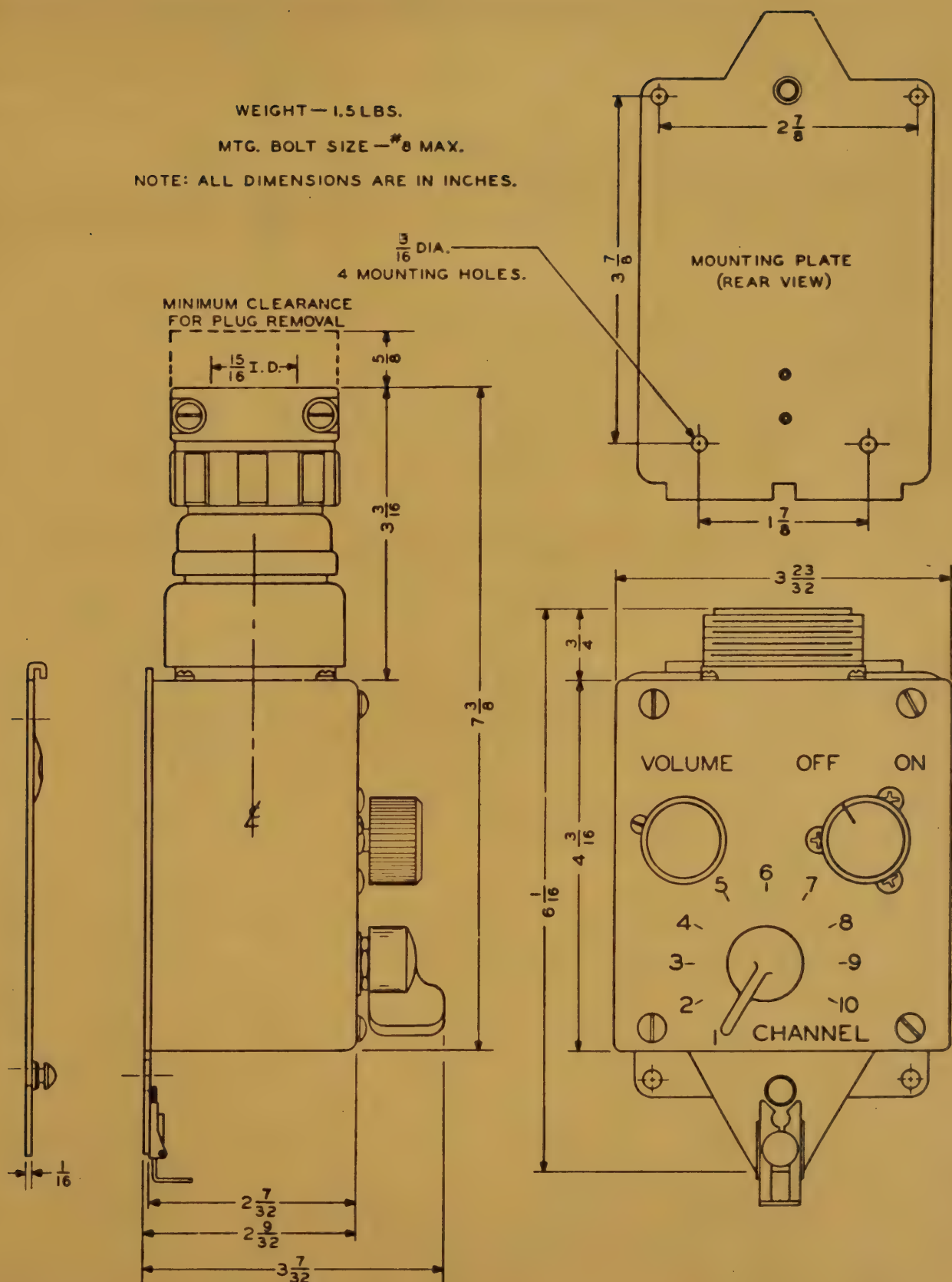


Figure 7-34 Control Box Mounting Dimensions



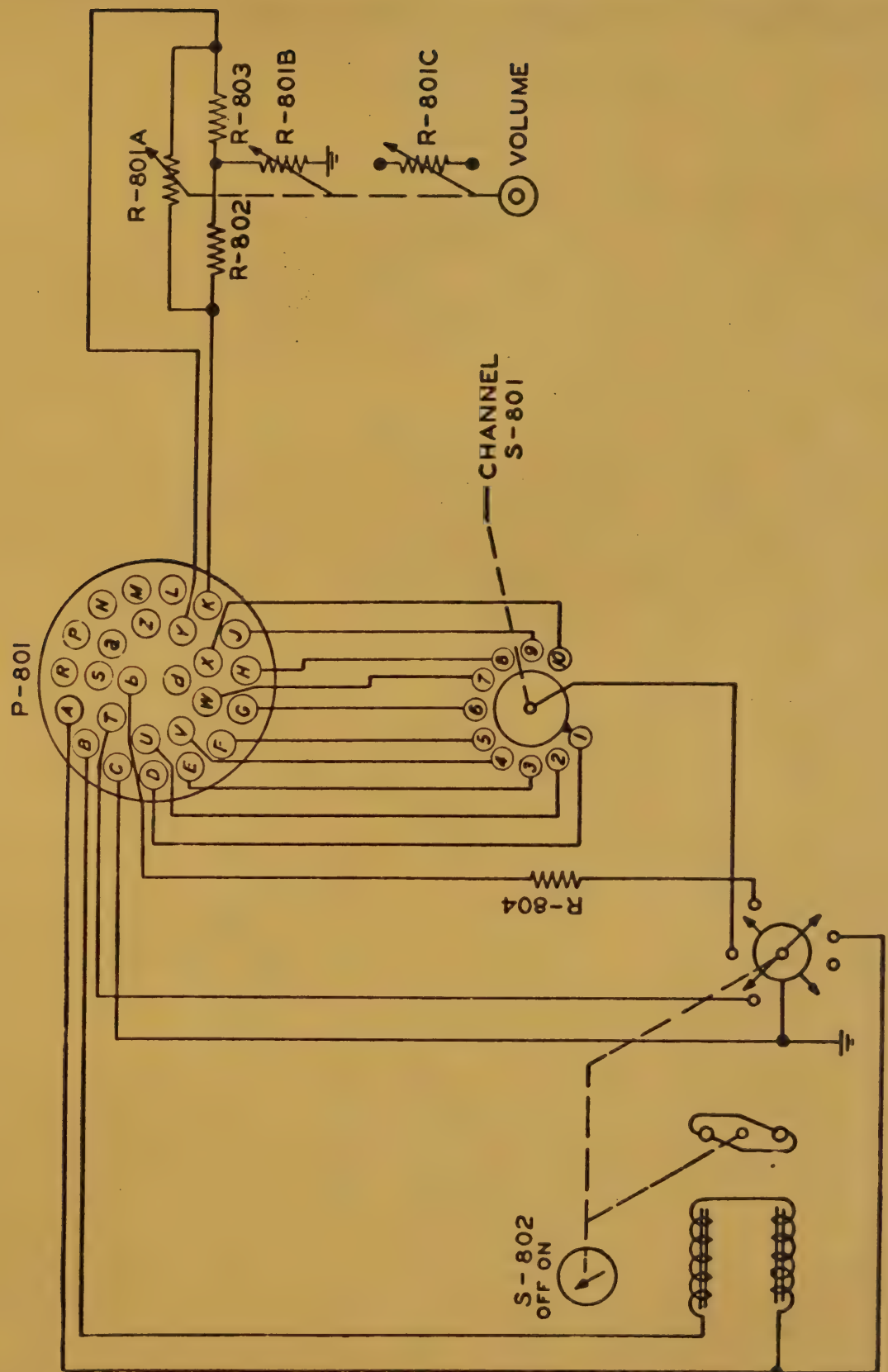


Figure 7-35 Control Box Schematic Diagram





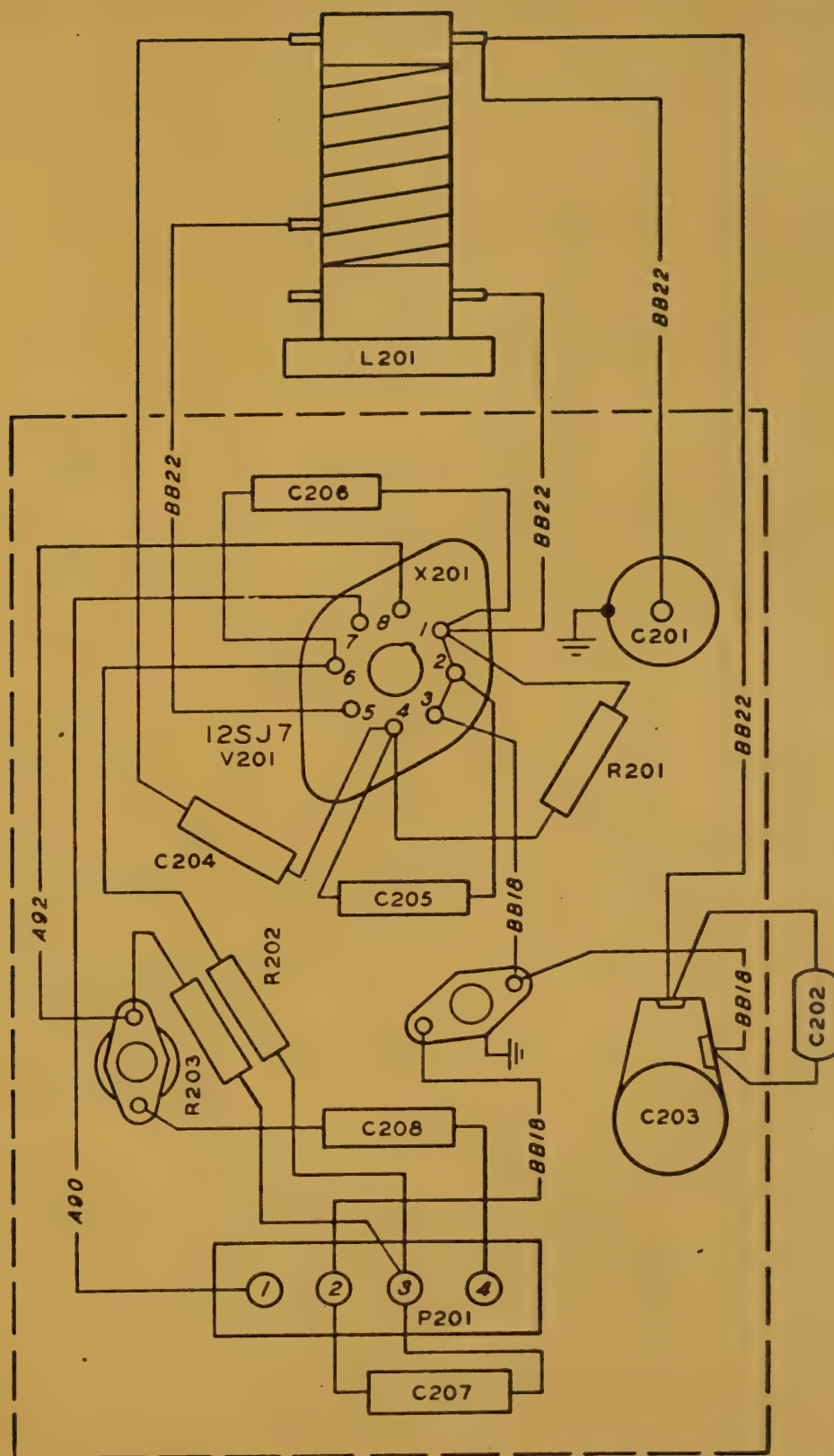


Figure 7-36 LF Oscillator Wiring Diagram



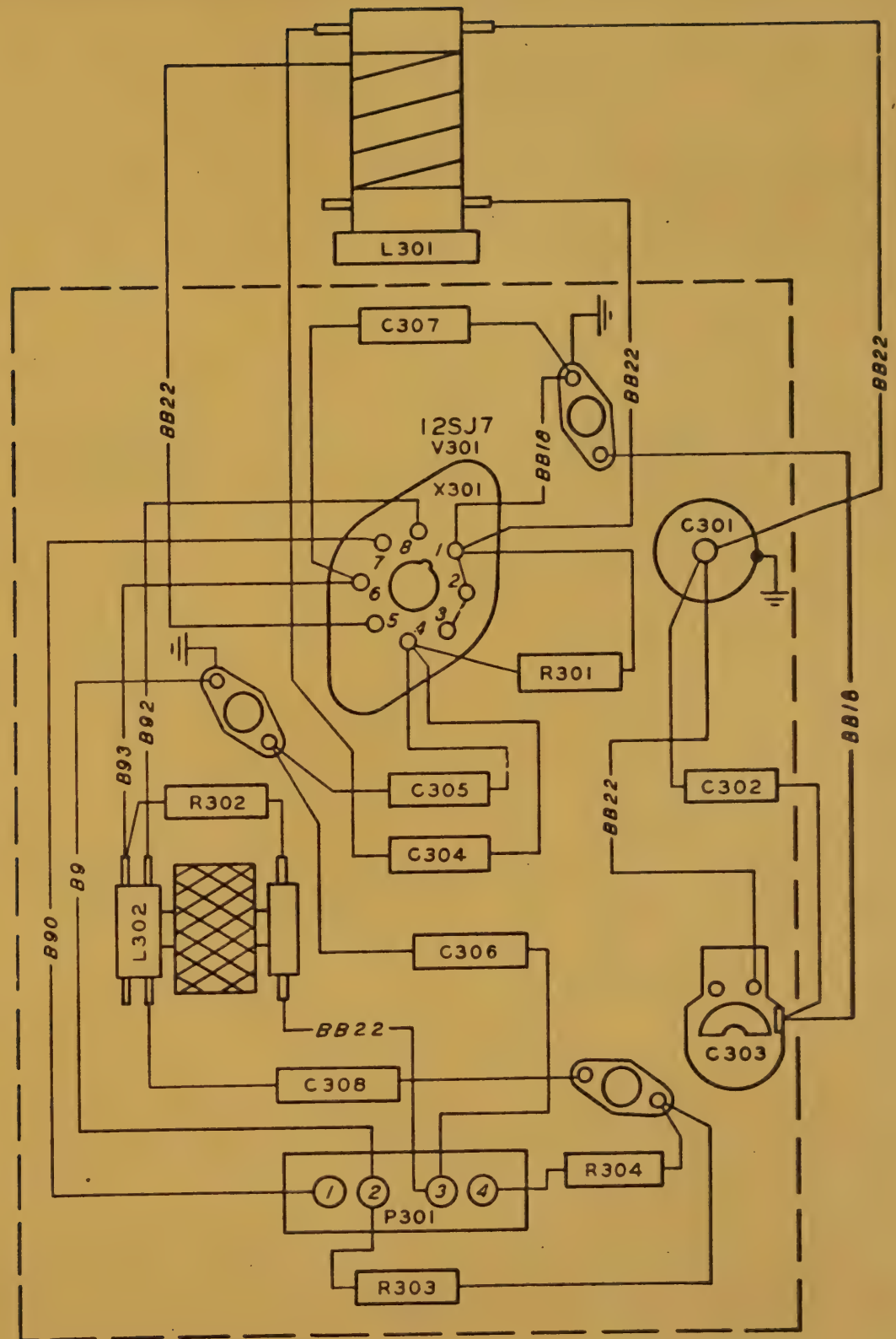
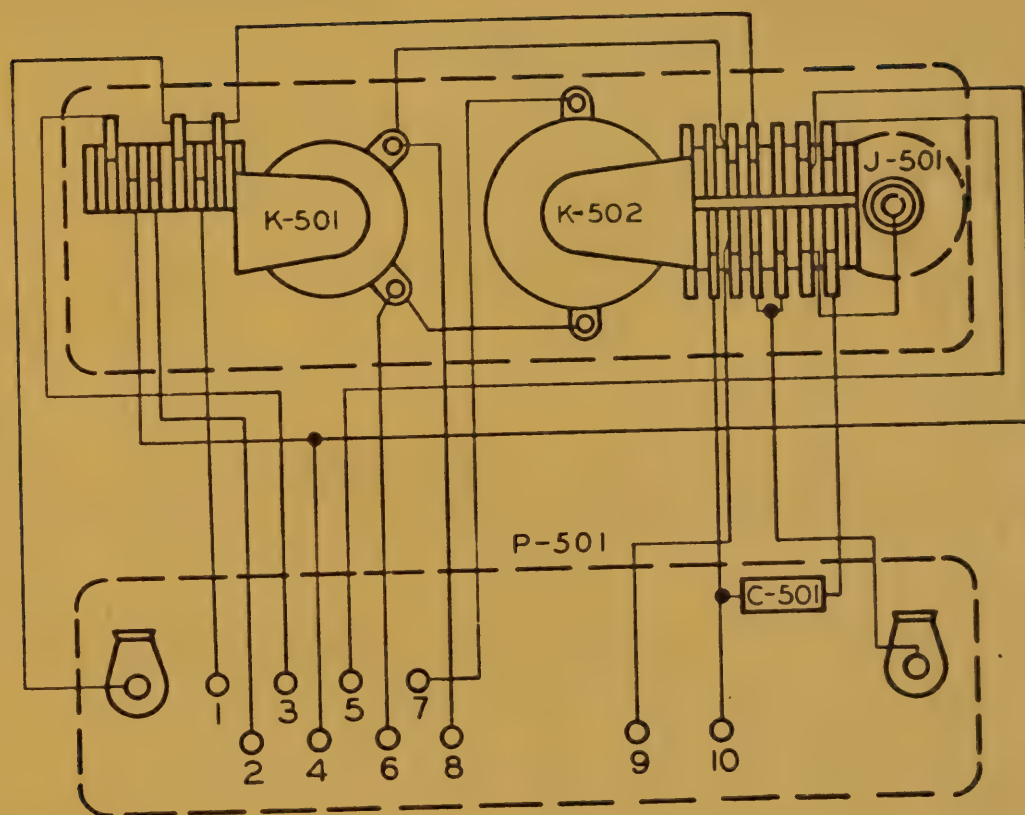


Figure 7-37 HF Oscillator Wiring Diagram



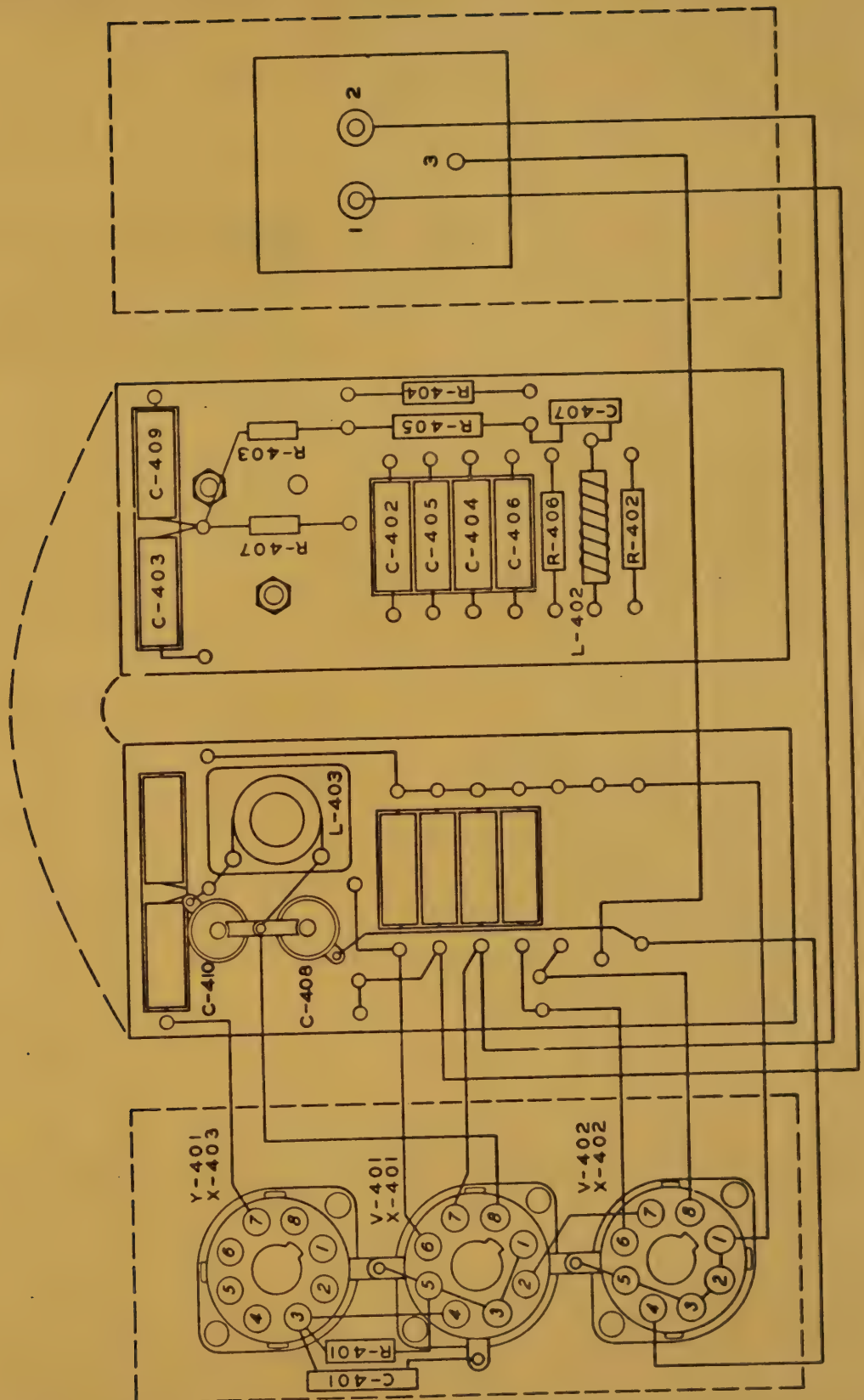




ALL WIRING #18 BUS

Figure 7-38 Relay Unit Wiring Diagram





ALL WIRING BB20

Figure 7-39 CFI Unit Wiring Diagram



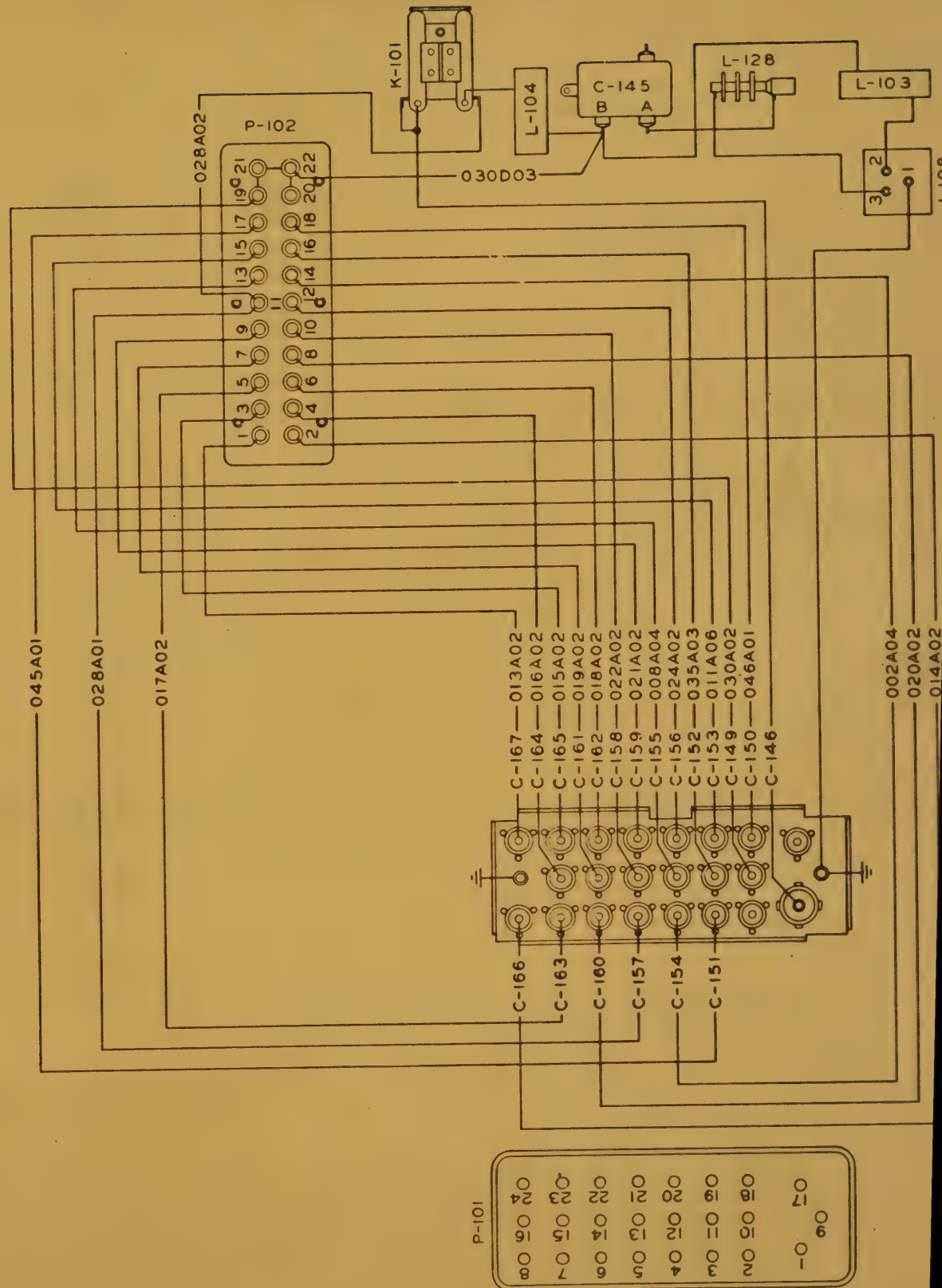


Figure 7-40 Filter Unit Practical Wiring Diagram





SERVICE REPORT  
REPLACEABLE COMPONENTS

Please fill out this form and submit it by mail to the COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA, USA, when reporting failure of component parts. A properly completed report must be submitted for each part before any accounts will be adjusted. An accurate report will assure the correct replacement part.

IDENTIFICATION OF COMPONENT

Owner \_\_\_\_\_  
Equipment Type No. \_\_\_\_\_ Serial No. \_\_\_\_\_  
Unit Type No. \_\_\_\_\_ Serial No. \_\_\_\_\_  
Component Item No. \_\_\_\_\_ Stock No. \_\_\_\_\_  
Description of Component \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SERVICE DATA

Date Equipment Received \_\_\_\_\_ Date in Service \_\_\_\_\_  
Date of Failure \_\_\_\_\_ Hours of Service \_\_\_\_\_

NATURE OF FAILURE

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

OPERATING DATA AND CONDITIONS (At time of failure)

Line Voltage \_\_\_\_\_ Abnormal Meter Readings \_\_\_\_\_  
Ambient Temperature \_\_\_\_\_ of Electrical Storm? \_\_\_\_\_  
Associated Fuse Failure \_\_\_\_\_  
Additional Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PRESENT STATUS OF EQUIPMENT

Out of Service \_\_\_\_\_ Component Replaced \_\_\_\_\_  
Temporary Repair (state nature) \_\_\_\_\_  
Date of Report \_\_\_\_\_ Signed \_\_\_\_\_

\* \* \* \* \*

THESE ENTRIES TO BE MADE BY THE COLLINS RADIO COMPANY

Received \_\_\_\_\_ R.T. No. \_\_\_\_\_ Replacement Order No. \_\_\_\_\_

Results of Factory Test: \_\_\_\_\_  
\_\_\_\_\_

Disposition \_\_\_\_\_  
\_\_\_\_\_

















